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A PROPOSED CONCEPT AND SCOPE FOR THE SAN JOAQUIN VALLEY AIR QUALITY STUDY

VOLUME 1 - SCOPING STUDY REPORT

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PREFACE

The purpose of the work reported here is to develop a general scope for a proposed San Joaquin Valley Air Quality Study. The main objectives are to identify problems of concern, delineate the goals of policy makers, articulate technical objectives that must be met in order to satisfy the policy objectives, develop a general proposed plan of attack, identify and scope main project segments and tasks within each segment, and estimate schedule and costs for a complete effort.

The scoping study is not a detailed work plan. The work plan will be a product of the first major segment of the effort. The product of the scoping study is a general depiction of the anticipated effort and an approximate estimate of costs; the work plan will provide a detailed specification of the proposed effort and refined cost estimates. We thus caution the reader to consider the report in light of these distinctions; read it as a scoping study and not as a work plan.

Certain additional aspects of the scoping effort should be noted at the outset:

> In accordance with the directive of the ARB contract manager, the work proposed and the costs estimated include all efforts that we conceived as being of potential value. Work proposed in the scoping that has been or is being carried out and that has not come to our attention, work proposed that is subsequently judged to be of limited or little value, work that may be duplicative - none of these will be undertaken. One purpose of preparing the detailed work plan is to identify and eliminate these occurrences. Work elements that are omitted from the final work plan for any of the reasons listed will, of course, reduce the refined cost estimate.

> The work proposed is to be carried out by those investigators designated by the governing Policy and Technical Committees, representing the signators to the Join Powers Agreement (JPA). Some of the work will be carried out by the various public agencies having an interest in the study. (For example, the ARB and county agencies will undoubtedly be responsible for a significant portion of the emissions study.) Where public agencies contribute "in-kind" efforts, the estimated costs will be reduced accordingly. (In preparing the cost estimates for the scoping study, no provision was made for "in-kind" contributions; all efforts presume an associated cost.) Other portions of the proposed work will be carried out under contract, with the contractors to be selected by the Policy Committee

> A management structure for the project has yet to be specified. This, of course, is a decision for the Policy Committee. However, to some extent the decision will influence costs.

> No provision has been made for contingency funds in the cost estimates. We suggest that a 10% contingency be added to the appropriation request, based on the cost estimate made at the completion of the work plan.

> No provision has been made for inflation.

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INTRODUCTION AND OVERVIEW

1. INTRODUCTION

This report outlines the scope and general content of a proposed multiyear, multistage San Joaquin Valley air quality study.

1.1 THE "AIR QUALITY - RELATED" PROBLEMS OF CONCERN

Several area-wide air quality problems are of potential concern in the San Joaquin Valley. They may be classified, although not unambiguously, into two categories: (1) exceedances of concentration levels specified in existing regulations, and (2) observed or suspected effects (some of which are governed directly or indirectly by ambient air quality standards).

(1) Exceedances of concentration levels specified in regulations

> Ozone. Ambient concentrations exceed State and Federal standards on numerous occasions during the summer months at locations throughout the Valley.

> PM-10. Ambient concentrations in most parts of the Valley exceed existing State standards and anticipated Federal standards at various times throughout the year.

> Visibility impairment. Visibility impairment exceeds that permitted under State standards. Since the regulation is not concentration-based and addresses an effect, this "problem" is discussed under (2).

(2) Observed or suspected effects

> Visibility impairment (Valley). Visibility degradation in the Valley can be substantial. In the autumn visibility in the Valley is frequently significantly impaired. The State visibility standard is violated at many locations in the Valley at various times throughout the year.

> Visibility impairment (Sierra Nevada and desert). The transport of pollutants from the Valley into the Sierra Nevada and the Mojave desert can lead to visibility impairment in areas of potentially high visibility. Of particular concern is visibility impairment at China Lake Naval Weapons Center and Edwards Air Force Base, sites where optical data collection systems are used in conjunction with flight operations and weapons tests. Visibility at these installations, and at existing monitoring sites in the Sierra, meets State standards; however, the desired high visibility that typified these areas in the past has been degraded and is at risk of continued and perhaps further degradation.

> Tree damage in the Sierra. Tree damage is observed over large portions of the Western slopes of the Sierra at elevations of 4,000 to 8,000 feet. Damage is attributed to ozone. However, other pollutant species may play a role in damage. Of concern is acidity -- dry- or wet-deposited materials, cloud or fog droplets, and gas phase nitric and sulfuric acids.

> Damage to agricultural crops in the Valley. Damage due to air pollutants has been reported for some crops. Extensive work has been funded by the ARB to clarify the "damage picture" - the crops being damaged, the extent of damage and economic loss, and the pollutants responsible for the damage. Because of the many variables other than air pollutants that affect crop quality and yields (e.g., weather, rainfall, pests, water quality), it is difficult to establish quantitatively the role of pollutants in crop damage. However, the studies to date have shown that air pollutants play a significant role in crop damage and that the potential economic losses are substantial.

> Health effects. Health effects are presumed to be taken into account through existing ambient air quality standards.

> Material damage. Recent studies suggest that damage to materials may be significant from an economic standpoint. As with crop damage, further work is needed to delineate the nature and extent of material damage in the Valley caused by air pollution. The scope of concerns posed by the supporting agencies does not include this category of damage; thus, pollutant effects on materials is not a specific focus of this effort.

Figure 1.1 presents a summary of air quality effects of concern; the pollutants responsible; averaging times, time periods and geographical areas of interest; and notation of the effects that will be given attention in this study.

1.2 THE GOALS OF THE POLICY-MAKERS

Policy-makers wish to take actions that will:

> in the nearer term (a) reduce concentration levels of pollutants exceeding ambient standards and (b) mitigate adverse effects (through ambient concentration reductions) attributed to air pollutants in the Valley and downwind of the Valley;

> in the longer term lead to attainment of the ambient air quality standards;

To support these actions, they must identify and develop well founded, effective emissions control strategies. To ensure that this objective is met satisfactorily, the scientific community must develop an improved understanding of current air quality in the Valley and surroundings and of the dynamics of atmospheric processes that influence air quality. Thus, the primary goals of the San Joaquin Valley Air Quality Study, in the nearer term, are:

> to improve our understanding of air quality in the Valley and surrounding areas through appropriate data collection, modeling, and data analysis efforts, and

> to use this improved understanding (and the information on which it is based) to estimate the impacts of alternative emissions control strategies on ambient ozone and PM-10 concentrations, visibility impairment, and possibly atmospheric and deposited acidity at various locations of interest in the Valley, at its downwind borders, and on the western slope of the Sierra.

Figure 1.1 Air Quality Effects of Concern

No.	Effects of Concern	Pollutants	Averaging Times of Interest	Time Period of Concern	Geographical Range	A Focus of this Study? *
1	Health Effects (as embodied in existing & forthcoming regulations)	ozone	1 hour	May to Sept.	valleywide	yes
2		PM-10	24 hour annual	year round	valleywide	yes
3	Visibility impairment	PM-fine (<2.5 µm)	instantaneous	year round	valleywide and transport into SE desert and the Sierra	yes
4	-- " --	PM-coarse (>2.5 µm)	-- " --	-- " --		yes
5	-- " --	NO_2	-- " --	May to Sept.		yes
6	Agricultural (crop) damage	ozone	peak hours, episodic periods, weeks.	growing season	valleywide	yes
7	-- " --	acidity?	unknown	-- " --	-- " --	no
8	Forest damage	ozone	days to weeks	May to Sept.	western slope of Sierra; 1200 to 2400 m elevation	yes
9	-- " --	acidity?	days to season	unknown (possibly March to May)		possibly
10	Materials damage	acidity?	long term	year round	urban areas (primarily)	no
11	-- " --	ozone?	-----	May to Sept.	-- " --	no
12	-- " --	other?	-----	-----	-- " --	no

* A "yes" indicates that the effect of concern is a focus of the proposed study. However, research will not be carried out on the efect, itself; rather, the impact of adverse air quality on that effect will be of concern.

Additionally, policy-makers must examine issues bearing on the feasibility of meeting air quality-related goals in pursuing their contemplated actions. These issues include determining:

> if it is, in fact, possible to attain the ambient standards without adopting draconian measures.

> if the direct and indirect costs of control are likely to be unduly high.

> if the uncertainties in estimated emissions reductions, control costs, and control effectiveness associated with alternative strategies will hamper sound decision-making.

[Note: Presumably, policy-makers will favor, among strategies of similar estimated effectiveness, that strategy (or those strategies) having the lowest associated uncertainties. Adopting such a strategy reduces the risk of failure or falling significantly short of expectations.]

> if there are significant technical or policy barriers to achieving "reasonable progress".

> if the transport of pollutants from upwind areas places substantial limits on the potential benefits of local emissions controls.

> if the quality of visibility in the southeast desert is likely to be improved appreciably by the controls needed to resolve air quality problems in the Valley.

> if future growth in the Valley can be accommodated while at the same time pursuing or maintaining attainment of air quality standards.

Finally, assuming that feasibility tests are met, policy-makers must be able to ascertain the extent to which alternative emissions control strategies satisfy stipulated regulatory requirements and policy guidelines. Specifically, acceptable strategies should:

> be consistent with attaining ambient standards for ozone, PM-10, and visibility. > account for emissions controls on the books" and anticipated future growth.	Standards attainment
> achieve reductions in ozone, and possibly acidity, in order to reduce or eliminate forest and crop damage. > reduce visibility impairment, consistent with satisfying DOD and NPS objectives and with the public's desires for substantial visibility improvement.	Effects mitigation (through ambient concentration reduction)

> be effective, in terms of cost of control per unit reduction in ambient concentrations

  [A topic of interest is the relative effectiveness of NO_x vs VOC emissions controls in reducing ozone concentrations in various locations in the Valley.]

> be effective over time, taking into account future growth

> be effective in meeting specified objectives simultaneously for all secondary pollutants and effects of concern.

Effectiveness

> be equitable in distributing controls upwind of and within the Valley.

> be equitable in distributing controls among jurisdictions within the Valley.

Equitability

The study must be planned so that its findings facilitate addressing the primary goals and the many attendant issues outlined here, including tests of feasibility and satisfaction of regulatory and policy requirements, insofar as they are technical in character.

See Attachment A for a discussion of the findings of interviews of policy-makers conducted as a part of this study. These findings form the basis for this summary of goals and objectives.

1.3 THE CHARTER OF THIS STUDY

The San Joaquin Valley Air Quality Study has two major goals. The nearer term goal (3 to 4 years) is to provide decision makers with (1) an improved understanding of the causes of ozone, PM-10, and visibility degradation in the Valley and surrounding areas, and (2) estimates of the impacts of alternative emissions control strategies. The longer term goal is to develop planning tools which will enable planners and decision makers to estimate the effects on air quality of future growth and to develop effective long term emissions control strategies for the Valley and upwind areas.

1.4. THE TECHNICAL OBJECTIVES OF THIS STUDY

In order to address and satisfy the primary nearer term goals of this study, including estimating the impacts of alternative emissions control strategies, it is necessary to address a series of supporting technical objectives. These include characterizing prevailing ambient air quality and meteorological conditions in the Valley, and developing, testing and applying source-receptor relationships.

Characterize prevailing conditions in the Valley --

(1) Characterize meteorology.

Characterize Valley meteorology, including transport patterns at the surface and aloft, vertical temperature structure and its temporal variation, formation of layers aloft at night and downmixing the next day, nocturnal ["jet"] flow aloft and decoupling of surface and aloft flows, transport patterns into and out of the Valley, up- and downslope flows, transport into the higher elevations of the Sierra, eddy structures and dynamics above the Valley, and areas and times of convergence and divergence.

Characterize current conditions in the Valley --

(2) Characterize air quality.

Characterize the spatial and temporal patterns and frequency distributions of ozone, PM-10, and PM-2.5 (concentrations and composition) in the San Joaquin Valley and nearby upwind areas. Characterize visibility impairment in the Valley. Characterize distributions of precursor (VOC, NO_x, and SO_2) concentrations. Characterize the speciation of VOCs. If appropriate, characterize acidity in the atmosphere (gaseous, aqueous, and particulate) on the eastern side of the Valley and at higher elevation and as deposited.

(3) Characterize pollutant fluxes.

Characterize the mass fluxes of primary and secondary species of interest (as noted in (2)) at various locations of interest -- entering, within, and leaving the Valley.

(4) Characterize emissions.

Document the amount, locations, and compositions of emissions from various source categories and individual sources that affect ozone, PM-10 and PM-2.5, and visibility impairment in the San Joaquin Valley and at its downwind borders. Estimate emissions from anthropogenic, biogenic, and geogenic sources judged to have an influence on air quality.

Develop source-receptor relationships --

(5) Develop an improved understanding of key dynamic processes.

Characterize the dynamic atmospheric processes influencing air quality in the Valley. Primary processes of interest include chemical transformation, transport, dispersion, and deposition.

(6) Develop source-receptor relationships.

Specify and develop approaches, including modeling and data analysis, for relating emissions and air quality.

(7) Estimate contributions of various sources to concentrations levels.

For locations of interest in (and downwind of) the Valley, estimate the contributions to ozone and PM-10 and PM-2.5 concentrations and to visibility degradation of emissions within individual locales, from other counties of the Valley, and from major upwind source regions.

Where feasible, evaluate the quality of predictive performance of the source-receptor relationships used.

Assess whether there are natural subregions of the Valley which are relatively unaffected by emissions from other subregions.

See Figure 1.2 for a schematic representation of the linkages among the primary and various supporting technical objectives associated with nearer term activities.

The longer term technical objective of the study is to develop models suitable for use in planning and evaluation that are capable of estimating the spatial and temporal distribution of ozone concentrations and, if appropriate, of secondary aerosol concentrations and composition. The models developed should be suitable for:

> Obtaining more reliable estimates of the types and levels of emissions reductions needed to achieve specified maximum allowable pollutant concentrations.

> Use in long term planning, including accounting for the air quality impacts of future population growth in the Valley.

> Codifying existing and newly acquired knowledge pertaining to air pollution in the Valley.

> Updating and improving estimates of the benefits of alternative emissions control strategies as added scientific knowledge becomes available.

1.5 AN OVERVIEW OF THE PROPOSED STUDY

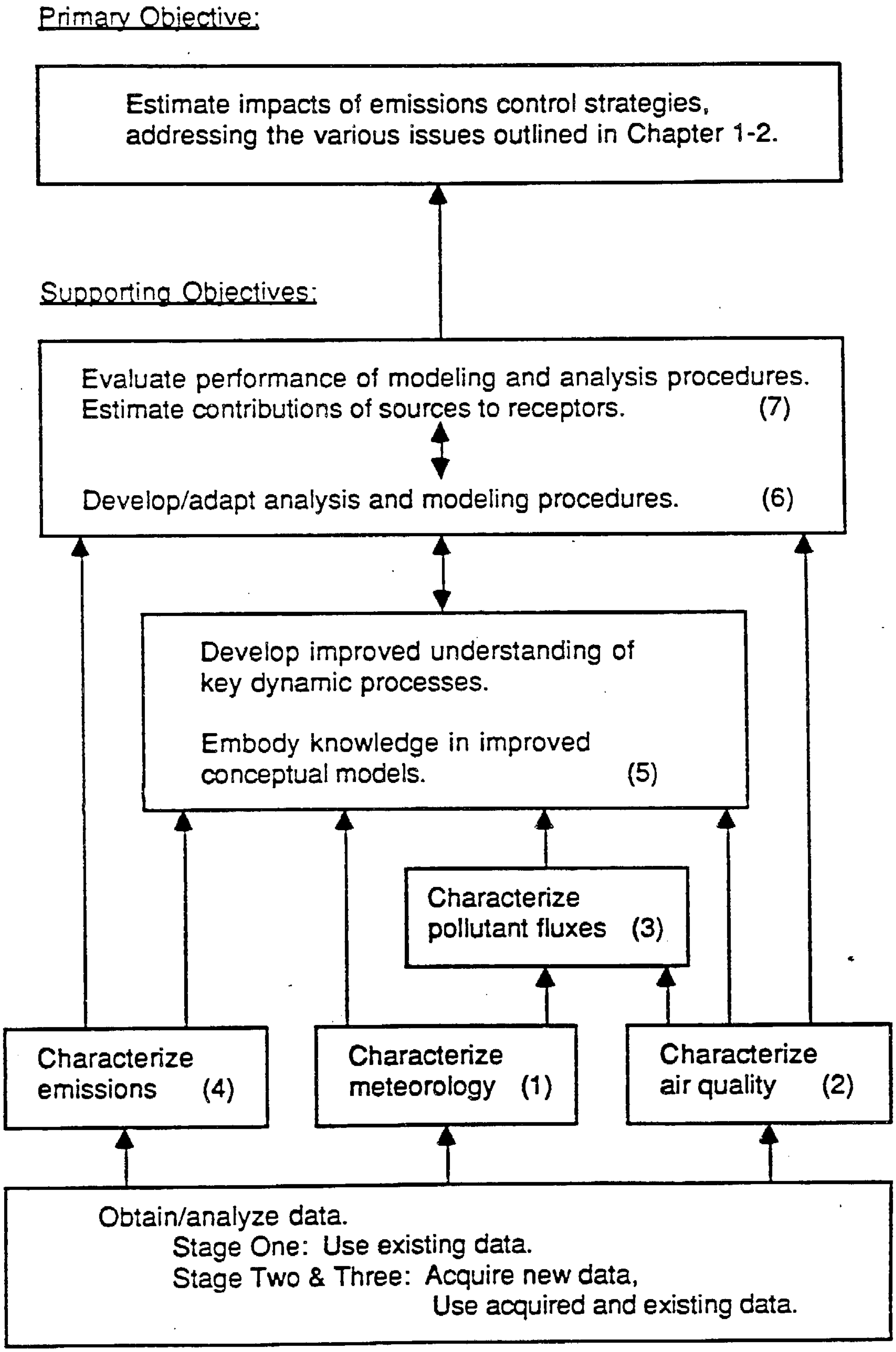
The overall study, as now conceived, would consist of three stages.

One. Study design, including full scale initial analysis
Two. Issue-resolving (nearer term) studies
Three. Development of a gridded photochemical model and other analysis approaches (longer term)

The first phase of Stage One is the current scoping study. This report summarizes the main features of the proposed effort, as developed in the scoping study.

Stage One is a comprehensive planning endeavor, consisting of an initial scoping effort (Phase 1), a full scale preliminary analysis (including modeling), to aid in planning subsequent portions of the study (Phase 2),

Figure 1.2. Linkages Among Technical Objectives



technical studies to develop specific scientific information needed to design Stage Two studies (also Phase 2), and preparation of a set of documents delineating in detail the project plan (Phase 3).

Stage Two is a comprehensive program of monitoring, modeling and analysis intended to satisfy nearer term (1989 to 1991) objectives. The primary purpose of the efforts proposed is to provide information to decision makers that will be of value to them in developing control strategies for reducing ozone and PM-10 and improving visibility. A second purpose of the Stage Two studies is to lay the groundwork and develop information for planning a longer term model development study (Stage Three), should it prove necessary or desirable. Major elements of Stage Two include continuous field monitoring; emissions determination and estimation, and preparation of a temporally and spatially resolved inventory; intensive episodic monitoring; continuation of selected technical support studies; and modeling and data analyses.

Stage Three comprises the planning, monitoring studies, and modeling and data analysis activities necessary to develop a comprehensive model(s) and other "tools" for use in long term planning for the Valley. Again, this stage will be carried out only if judged necessary and potentially fruitful, based on the findings of the Stage Two efforts.

See the flow diagram in Figure 1.3 depicting elements of the overall study and their interconnection.

In Chapter 3 we summarize the main features of each Stage and the phases or elements comprising them.

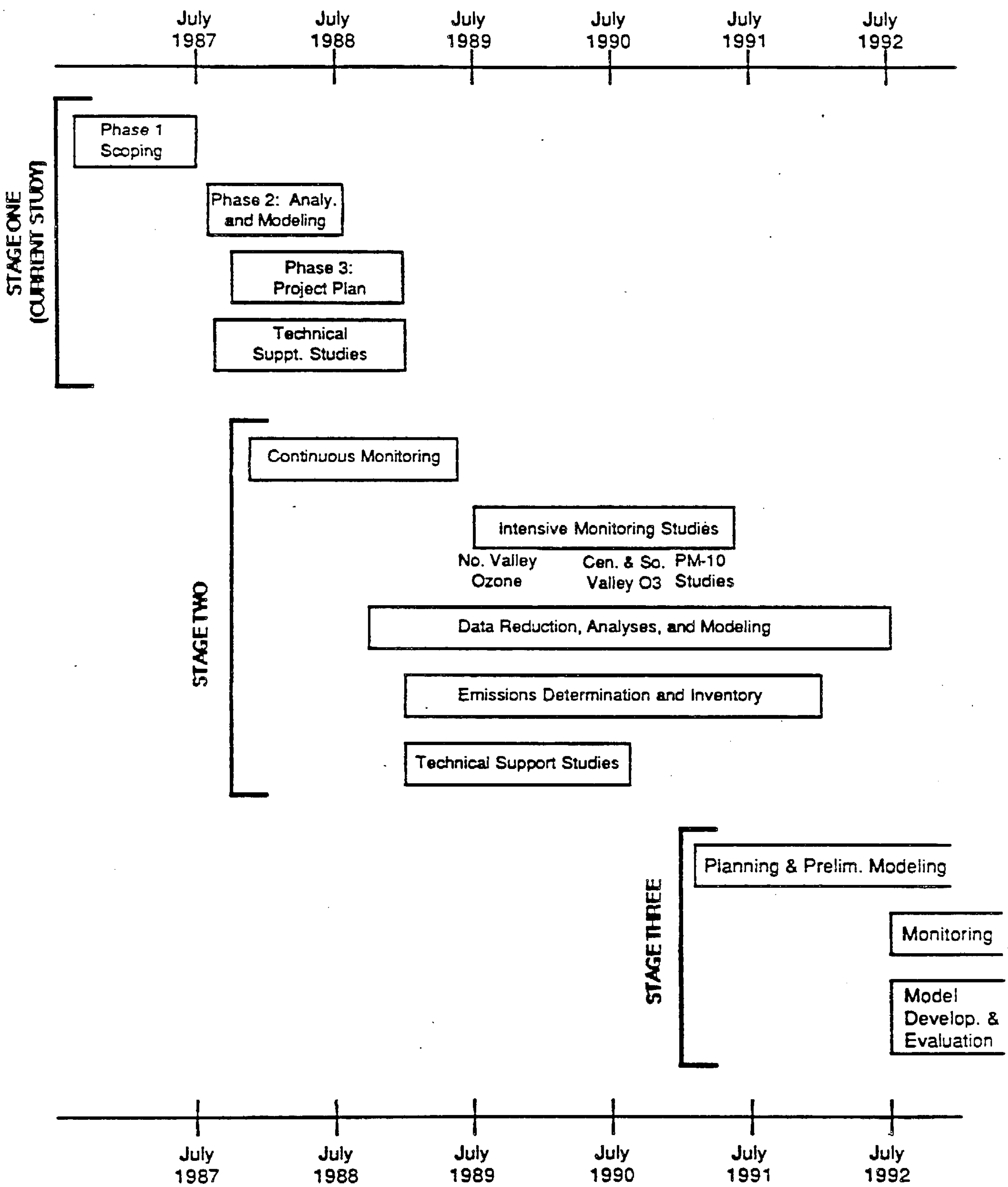


Figure 1.3. Base Schedule For San Joaquin Valley Air Quality Study

2. PRINCIPLES GUIDING THE DESIGN OF THE PROJECT

The scope of a project of this size and complexity can take many forms. Guidelines are needed to set direction for planning. Many ideas were offered in initial planning efforts and during project reviews by technical and policy experts. A number of general considerations emerged as being of primary importance. These derive from the objectives set forth in the Introduction, and are based on past experience and current needs. We present them here as principles guiding the project design.

General

(1) Develop a plan intended to contribute to the solution of the problems identified, not merely to achieving better understanding.

(2) Focus clearly and exclusively on the objectives of the project in developing the plan. Relate all aspects of the plan to these objectives.

(3) Develop specific questions, deriving from the technical objectives, that the study is intended to answer. The more considered and definitive the questions, the more likely it is that the plan will satisfy the needs.

[Note: Specific, definitive questions are not presented in this scoping study. However, the remaining elements of the sequence are followed. Specific questions will be developed later in Stage One, following further interaction with technical staff and policy-makers of the supporting agencies. The overall plan will then be refined correspondingly. See also item (7).]

(4) In planning the study allow for the pursuit of all paths of inquiry that may be of potential interest or concern.

[Example: Include a plan for the study of acidity on the western slopes of the Sierra, assuming that acidity may play a role in tree damage. If information emerges that indicates that acidity is not an important factor, it can be dropped from the study subsequently.]

(5) Design the study to provide findings of potential use to policy makers at each stage, including the planning stage. Findings pertaining to the development of nearer term strategies are of particular interest.

(6) Design the study to produce useful modeling and analysis tools in the nearer term, even though such a product is only a secondary objective in this time frame. [Refined modeling and analysis tools are the primary intended product of the longer term endeavor.]

Technical

For all pollutants of interest --

(7) In designing the program, plan according to the following sequence: set objectives, develop questions, identify appropriate modeling and analysis approaches to address questions, and develop plans for data acquisition. Allow each element to derive from the needs of the preceding element.

(8) As a part of the planning effort, carry out a full scale analysis of air quality in the Valley, using available data and source-receptor relationships, in order to better identify information gaps, preferred modeling and analysis approaches, and data needs. Carry the effort as far as the existing data base will support, including a preliminary assessment of emissions control requirements and the effectiveness of alternative control strategies. Develop requirements for emissions information.

(9) Plan the ozone, PM-10, and visibility portions of the study independently and separately, so that the individual requirements of each are attended properly. Then create a plan integrating common elements of each (such as large portions of the meteorological data collection effort) to develop an efficient and cost-effective study.

(10) Give adequate emphasis to development of sound, reliable emissions information. [Past studies have emphasized aerometric data collection and de-emphasized the gathering of needed emissions information. Experience suggests that priorities should be adjusted toward greater emphasis on the need for emissions information.]

(11) Select analysis tools most suitable for the need. Where possible, consider developing alternative, independent modes of analysis, to permit comparison and corroboration. Preliminary judgments based on experience (a) favor modeling for the ozone portion of the study, while considering alternative forms of analysis as well, and (b) emphasize data analysis for the PM-10 and visibility portions of the study, while including modeling approaches as well.

Relating to Ozone --

(12) Take full advantage of what has been learned from the studies carried out in the Valley and surrounding areas.

Note particularly the findings of the Kern County monitoring and modeling studies carried out from 1984 to 1987.

(13) Based on past experience, emphasize data collection during intensive periods. Give next priority to determination of emissions. Routine monitoring should receive third priority.

(14) Give priority to modeling in selecting source-receptor approaches. However, consider the merits of correlational and other analyses in diagnostic studies.

Relating to PM-10 and Visibility --

(15) Select approaches to relating sources and receptors prior to designing the study. Identify preferred approaches as a finding of the full scale analysis of air quality in the Valley that is to be carried out in Stage One. Design the study (Stage Two) to meet the data requirements of the source-receptor relationships, which in turn are selected to best satisfy overall objectives.

(16) Attempt to relate individual chemical components of observed particle mixtures, i.e., as measured at the source and the receptor. Consider analysis approaches having roots in both the emissions and the air quality data bases.

(17) Emphasize continuous monitoring in planning these studies. Give high priority also to estimation of emissions. Give third priority to intensive studies.

(18) Stress characterization of particle composition at receptors and emanating from sources.

3. GENERAL APPROACH TO THE STUDY

3.1 STAGE ONE. STUDY DESIGN AND SUPPORTING ANALYSES

3.1.1 Phase 1. Current scoping study

The primary objectives of this effort are to develop an overall conceptual framework for the study's three stages, to estimate the costs of carrying out the study, and to develop a schedule for the work. Supporting organizations need this information to discuss the merits of the effort, its chances of success, the desirability of funding it, the amounts of money appropriate to commit, the timing of deliverables, and the likelihood that results can be provided when needed. Other key elements of this effort are surveying policy representatives of participating organizations to establish project objectives, reviewing the literature, and developing a conceptual model of the dynamics of processes influencing air quality. The product of Phase 1 is this report and its attachments.

3.1.2 Phase 2. Full scale analysis and technical studies in support of the project design

The primary purposes of Phase 2 are (a) to identify and apply suitable analysis and modeling approaches for estimating relationships between sources and receptors and the impacts of emissions control strategies and to assess the performance potential of these approaches using existing data; (b) to develop a "best possible assessment" of information that should be acquired in Stage Two field studies; and (c) to acquire a variety of technical information needed to develop a sound plan for the Stage Two effort. A secondary purpose is to provide decision makers, insofar as is feasible, with initial findings that may be of value to their deliberations during the next year.

Specific tasks comprising Phase 2 include (1) preparing a detailed plan for the technical support studies to be carried out in this phase; (2) characterizing present conditions in the Valley; (3) developing approaches for analysis and modeling for Stage Two; (4) carrying out technical support studies to gather technical information not now available; (5) applying and testing the approaches developed in task (3) using available data, models, and analysis "tools"; and (6) attempting, through modeling and analyses, to address in a preliminary way the nearer term policy-related objectives discussed in Chapter 1.

Thus, as now envisioned, a major component of this effort would be to carry out a full scale analysis of existing data, using available tools and techniques, in order to identify alternative emissions control strategies and to estimate the air quality impacts of each. Efforts will consist of acquiring available meteorological, emissions, and air quality data, applying existing models, carrying out data analyses using approaches already developed, and interpreting the results of these studies.

Tasks (3), (5), and (6) of Phase 2 comprise, in effect, a thorough and complete analysis intended primarily to aid in developing a detailed project plan. As noted, the work also will attempt to address major technical objectives, providing preliminary information and findings that may be of value to policy makers in the short term. Because of the preliminary nature of the analyses and the sparse data supporting them, findings will be evaluated for merit and presented with a clear discussion of limitations and uncertainties.

A second major component of Phase 2 will be planning and carrying out a series of technical studies, several involving field work, that are also intended to develop information needed to plan and carry out the Stage Two effort. Tasks (1), (2), and (4) comprise this effort. Task (2) efforts generally comprise "paper studies" relying on available data, while Task (4) activities frequently involve collection of data in limited field studies.

The product of the Phase 2 effort will be a set of five reports, the contents of which are briefly discussed in section 4.2.7. One of the reports will describe the work carried out and present findings that will be used by the contractor in preparing the planning documents in Phase 3.

3.1.3 Phase 3. Preparation of project plan (documentation)

The purpose of Phase 3 is to develop a project plan, embodied in a set of four reports delineating in detail the proposed project design.

(1) Project Protocol

The project protocol will present detailed descriptions of all modeling, analysis, and monitoring activities recommended for inclusion in the study. This document will describe <u>what</u> we recommend be done and <u>why</u> it should be done.

(2) Design Document

This document will provide a detailed description of the proposed field monitoring program for Stage Two. This document will focus on <u>how</u> to carry out field studies.

(3) Emissions Studies and Inventory

The emissions document will specify studies needed to develop accurate estimates of emissions factors and activity levels for specific categories of sources and individual sources and will delineate efforts required for compiling accurate and complete inventories, including a gridded inventory.

(4) Stage Two Technical Support Studies

This document will prescribe requirements for a continuation of a few technical support studies initiated in Stage One and for any additional studies suggested during or following Phase 2 efforts. (See the section 4.2.4. for a discussion of the technical support studies presently proposed.)

3.2 STAGE TWO. ISSUE-RESOLVING (NEAR TERM) STUDIES

The Stage Two studies will consist of continuous and intensive monitoring, emissions determinations and inventory development, and data analysis and modeling intended to improve our understanding of air quality in the Valley and surroundings and of the dynamic processes influencing air quality, and to provide an improved basis for developing sound, effective, equitable emissions control strategies.

3.2.1 Element 1. Continuous monitoring

Continuous monitoring will consist of a sparse surface and upper air monitoring network operated for the length of the project to measure appropriate air quality and meteorological variables. This network is intended to provide a limited data base, to which data collected during intensive monitoring periods will be added. Some uses of the information collected will include (a) primary support for PM-10 and visibility analyses; (b) developing annual statistics for PM-10; and (c) identifying categories of episodes and their frequencies of occurrence, estimating variability within categories, and attempting to determine representativeness of an episode within a category.

3.2.2 Element 2. Emissions determinations and compilation of an inventory

Emissions-related efforts will focus on (a) establishing reliable estimates of emissions from all source categories that significantly influence ozone and PM-10 concentrations and visibility impairment, (b) compiling a gridded, temporally resolved inventory for the Valley using the emissions estimates established, and (c) constructing episode-specific inventories based on estimated variations from the general gridded inventory. Stress will be placed on obtaining accurate estimates of emissions factors and activity levels, as compared with relying solely on published emissions information and estimates developed under other conditions and in other areas. In effect, the product will be best estimates of emissions factors and activity levels, including significant uncertainties, and an inventory of a quality suitable for supporting "state-of-the-art" analyses. [Note: Existing estimates of emissions factors and activity levels, as developed by the ARB and county agencies, will provide the starting point for establishing final estimates for use in the study.]

Topics of attention will include developing or establishing estimates for anthropogenic, biogenic and geogenic sources; developing basic emissions information for all primary pollutants and precursors in spatially and temporally resolved format; characterizing the sources and source strengths of primary particles (including agricultural sources, fugitive dust, and open burning) and the composition of their emittants (including source testing and acquiring chemically speciated data); intensive examination of area source inventories, including improving estimates of emissions from "uncertain" categories; identifying emissions and developing estimates for sources not previously included in inventories; and characterizing sources of precursors of ozone. The inventory will be used in relating sources and receptors through analyses of data; in comparing within-Valley emissions with measures of atmospheric loading and incoming fluxes of pollutants; as input to models; and in evaluating the performance of models.

3.2.3 Element 3. Intensive monitoring

Efforts embodied in this element involve performing air quality and meteorological monitoring and tracer studies in subregions of the Valley to better understand three dimensional pollutant distributions, to document transport patterns, to acquire a data base to support development of source-receptor relationships for relevant pollutant species, and to provide a general basis for analyses to meet the technical objectives.

As noted in Chapter 2, intensive monitoring will be given emphasis in plans for summer ozone-related studies. [PM-10 and visibility will be studied during these summer periods as well.] Plans will also be developed for intensive monitoring in other seasons for PM-10 and visibility episodes at reduced levels of effort.

3.2.4 Element 4. Supporting technical studies

Element 4 comprises supporting technical (monitoring and analysis) studies, intended to develop information needed to design and carry out continuous monitoring, emissions estimation, and Stage Two and Three efforts more effectively. Studies included here will be (a) those carried over from Stage One and (b) those suggested as a consequence of needs identified during the Phase 2 effort. Studies of limited scope that produce technical (not policy-related) outputs are envisioned.

3.2.5 Element 5. Modeling and analysis

The purpose of this element is to carry out analyses of the data collected, focusing on meeting the objectives of the project, as stated in Chapter 1. These analyses will be undertaken for ozone, PM-10, and visibility.

Specifically, the efforts will include performing modeling (including the use of models exercised in Stage One) and data analyses using the continuous data base and data collected through intensive monitoring during episodes of interest in order (a) to develop improved understanding of governing atmospheric processes; (b) to develop improved source-receptor representations for selected adverse air quality episodes, and, for particles, for both seasonal and annual periods; and (c) to estimate the impacts of alternative emissions patterns and levels of emissions reductions.

3.3 STAGE THREE. FULL SCALE MONITORING AND MODELING STUDY

The objective of Stage Three is to develop reliable models and other relationships for relating sources and receptors. (See Chapter 1 for a complete statement of objectives.) The work elements of this stage will consist of a full scale monitoring program for selected episodic situations and a subsequent modeling program having as its focus the development of a reliable grid-based model for ozone and a model(s) or other source-receptor relationship(s) for PM-10 and visibility. The geographical extent of application of the model or relationship may be the Valley as a whole or each of three segments of the Valley (the north, central and southern portions). As noted, Stage Three will be pursued only if Stage Two efforts and related findings do not adequately satisfy the needs of policy makers, or if developing a model for long term use is desired. In any event, the design of Stage Three will await completion of Stage Two, a decision to proceed with Stage Three, and early Stage Three modeling. These caveats notwithstanding, one might anticipate that the following elements will comprise the effort.

3.3.1. Element 1. Early Stage Three modeling

Carry out modeling to aid in preparing the Stage Three plan. Incorporate the findings of Stage Two studies, improve working hypotheses, and carry out sensitivity runs aimed at improving the design of the observational effort.

3.3.2 Element 2. Development of a Stage Three project plan

Prepare a detailed plan for monitoring and model development and evaluation. Prepare a field program design document.

3.3.3 Element 3. The monitoring program

Execute the field program.

3.3.4 Element 4. Model development and performance evaluation

Carry out all model development and exercise tasks.

3.4 SCHEDULE

The times of inception and time requirements for the phases of Stage One and elements of Stages Two and Three are shown in Figure 1.3. About six to eight months will be required to complete the modeling and data analyses contemplated for Phase 2, and about a year will be required to carry out the technical support studies. Properly, final design of the Stage Two effort would await their completion. If the Phase 2 efforts are completed by summer 1988, major field studies would not begin until summer 1989 (allowing up to six months to finish Phase 3). However, some participating agencies have indicated that this delay in initiating the Stage Two intensive monitoring studies may be unacceptable. They have strongly expressed their interest in beginning these studies earlier - during the summer of 1988.

In recognizing the existence of various viewpoints regarding time schedules, we have developed a "base" schedule that allows time to complete all Stage One activities needed to plan Stage Two and two accelerated schedules that provide for a first intensive program during summer 1988. [Of these two schedules, one places the second intensive in 1989, the third in 1990. The other places both in 1989.]

Because plans for a summer 1988 intensive will not draw on the full body of information generated in Phase 2 and because Phase 3 will not be completed in the needed time frame, risks of not designing an "optimal" intensive are significant. These risks are discussed in Chapter 9. However, should the committees opt for an accelerated schedule, an attempt will be made to complete portions of Phase 2 as early as possible, so that their findings may be drawn upon in planning the summer 1988 activities.

The base plan possesses three attributes that support minimizing the time to inception of the major studies:

> An overlap in the schedules for Phases 2 and 3.

> Initiating continuous monitoring, an element of Stage Two, during the Stage One activity. This early start permits the gathering of certain essential data as soon as possible.

> initiating technical support studies as early as possible in Phase 2.

Finally, budget limitations may delay the time at which Stage Two activities can commence. An additional (fourth) schedule reflects an option that takes into account possible funding delays.

We will discuss the various scheduling options with the technical and policy committees, including the costs, benefits, and risks of accelerating or delaying the schedule. The committees can then determine which schedule to adopt.

SECTION II

STAGE ONE -- PROJECT PLANNING

4. PHASE 2 OF THE PLANNING EFFORT

4.1 OBJECTIVES AND OVERVIEW

As discussed in Chapter 3, the purpose of Phase 2 is to carry out activities that will contribute to preparing a sound, effective plan for Stage Two. A primary component of this effort is a full and complete analysis of meteorology and air quality in the Valley - for ozone, PM-10, and visibility - using available data, previously successful analysis approaches, and existing models. A second component is the technical support studies, each clearly defined and of limited scope, that are intended to generate information that is unavailable or presently inadequate for project needs.

Carrying out detailed data analyses and modeling, of the types ultimately desired, provides an attractive means for identifying potential flaws and limitations of alternative analysis approaches, selecting preferred approaches, establishing data requirements for these approaches, assessing the sensitivity of air quality estimates over the ranges in uncertainty of key variables, and gaining a general "feeling" for analysis and data needs and potential problems.

Separate analyses will be carried out for each "pollutant", using common data bases and analysis approaches where feasible. Ozone-related air quality will be studied for summer episodes. PM-10 will be studied in each of three seasons, and an annual analysis will be attempted as well. [Episodes occur in both the summer/autumn and winter seasons, with differing characteristics. Autumn is also of interest because of agricultural burning.] Adverse visibility episodes will be analyzed for up to three seasons.

4.2 PROPOSED TASKS

In this section we discuss the tasks comprising the technical support studies and the analysis efforts. Many paragraphs of the section conclude with a notation of the form, "obj n". This notation is intended to indicate the supporting objective listed in Chapter 1 which the work described addresses.

4.2.1 Task 1. Planning the technical support studies

At present we recommend that up to thirteen technical studies be planned and carried out in support of the Stage Two and Three efforts. The number of studies recommended and their specifications may change somewhat as plans develop. The task content of each will derive from existing informational needs. These studies will range in costs from $50,000 to $400,000. The scope of each technical support study is presented in Attachment G.

The detailed plan for each study, as developed in this task, will include the objective, planned products, the needs of Stage Two and Three studies being satisfied, the proposed approach, delineation of monitoring or data collection tasks (if appropriate), a data analysis plan, estimated costs, and schedule.

The studies will be carried out as Task 4 of Phase 2. See section 4.2.4 for brief summaries of the technical support studies proposed.

4.2.2 Task 2. Characterizing present conditions (using available data)

As a first step in planning we recommend taking advantage of the information to be gained in acquiring and analyzing available data. In Attachment B we present a review of the relevant literature, noting past studies and sources of information. We recommend here some specific activities, analyses, and syntheses of past studies that we believe will be illuminating.

> Acquire, assemble, and analyze available meteorological data. Develop improved descriptions of flow patterns aloft (including nocturnal jets), stratification aloft, vertical temperature and stability patterns, upslope and drainage flows, eddy structures and dynamics, zones of convergence, and transport into and out of the Valley. (obj 1)

> Analyze available air quality data to characterize geographical and temporal patterns in the concentrations of ozone, NO, NO_2, and VOC. (obj 2)

> Assess, through a review of historical O3, PM-10, TSP, and visibility data, the frequency and patterns of occurrence of exceedances of the ambient standards, their duration, and seasons of most frequent and severe exceedances. (obj 2)

The information derived from these tasks will be of value in developing a sampling plan for continuous and intensive monitoring.

> Analyze existing particle data for the Valley to develop estimates of the size distribution and composition of ambient aerosols. Determine compositional variations of PM-10 within the Valley to gain an understanding of the relative importance of primary vs. secondary aerosols. Carry out analyses for seasonal and annual periods. Analyze existing (unanalyzed) filters, as appropriate. (obj 2)

Some methods for performing the above analyses are described in Section 8.9 of Attachment D.

The information developed will be used to define the types of chemical analyses required for continuous monitoring and the most appropriate types of data analyses to adopt.

> Analyze available instrumental and filter data in an attempt to allocate contributions to light extinction among its various causes - Rayleigh scattering, NO_2 absorption, elemental (black) carbon absorption, fine particle scattering, and coarse particle scattering. Characterize the geographical, seasonal, source-related, and statistical patterns using all available data, including airport data. (obj 2)

> Review the flux calculations from the 1979-80 San Joaquin Valley Study to estimate the relative importance of transport from the Bay Area. (This work will complement the estimates of fluxes derived from modeling.) Estimate, if possible, the extent of dilution of imported pollutants for the various episodic scenarios identified above. Also, review other studies that examine fluxes at other locations in the Valley. (obj 3)

These findings will be used, in conjunction with the modeling results, to assess the priorities that should be given to making flux measurements in various regions and to determine the spatial and temporal density of wind measurements required to support flux estimation.

> Attempt to develop, based on existing data, an inventory of gaseous pollutant emissions for use in modeling and data analysis. Identify uncertainties, data needs, and accuracy requirements. (obj 4)

> Develop a size- and composition-resolved inventory of primary particulate matter for the Valley for five components (sulfur, nitrogen, organics, elemental carbon, and soil) and for "tracer elements". Size cuts might be: < 2.5 μm, 2.5 to 10 μm, and > 10 μm. (obj 4)

The results of the emissions-related studies will provide important information for the corresponding technical support study, which will develop the plan for element 2 of Stage Two.

> Review the available meteorological data associated with episodes, including synoptic patterns, 850 mb temperatures, ventilation strength, winds aloft, fog occurrences, and relative humidity (RH) in order to determine atmospheric scenarios associated with exceedances. (obj 5)

This information will be used to develop a forecasting approach for the intensive studies. (This work may be included instead in a technical support study.)

> Define a methodology for carrying out a mass balance calculation for nitrogen and/or sulfur for one or more designated areas. Attempt to complete a mass balance. Identify major information deficiencies limiting the effort.

A primary purpose of this is to identify and reconcile inconsistencies between emissions and air quality determinations.

Other analysis efforts may be added to this list.

4.2.3 Task 3. Identifying approaches for analysis and modeling for Stage Two

In identifying analysis approaches, attention should first be given to the program objectives and to the availability of data needed to support the analyses envisioned. Candidate analysis approaches for ozone, PM-10 and visibility must then be evaluated and preferred approaches selected for further consideration and use. For planning purposes we offer some initial thoughts about approaches; these may well change once the available options are fully evaluated at the beginning of Phase 2.

A conceptual model of the dynamic processes governing pollutant concentrations in the San Joaquin Valley and the Sierra Nevada has been developed during Phase 1. The intent was to bring together the current scientific understanding of governing processes, including their interactions. This "model" can serve as a basis or reference in evaluating the merits of alternative "mathematical" and computer-based analysis and modeling approaches for use in Phase 2 and subsequent stages. The conceptual model can also be updated as improved understanding is gained. See Attachment C for a presentation of the conceptual model. (obj 5)

Experience suggests that urban or regional scale grid-based photochemical modeling would be suitable for ozone. An attractive starting point is the recent regional modeling carried out for the Valley by Systems Applications, Inc. (SAI) under the support of the National Park Service. The Regional Transport Model (RTM-III) was applied for a two day episode using a 10 x 10 km grid for the region of the Valley from Merced to the Tehachapis. The modeling region, which includes the three national parks of the Sierra, could be extended to include the northern portion of the Valley. The RTM-III, with prepared inputs, is available for use. (obj 6)

The SAI Urban Airshed Model (UAM) is now being applied for a study in the San Francisco Bay Area. Once this application is completed, the model will be available for estimating pollutant fluxes from the Bay Area into the Valley for a selected meteorological episode. Use of the RTM-III for the Valley and the western Sierra slopes and the UAM for the Bay Area would facilitate exploring data needs through sensitivity and uncertainty analyses. In both instances existing input files would be used to the extent appropriate to take advantage of past work. (obj 3)

In 1985-87, the UAM was applied to Kern County by both the ARB and SAI in a series of thorough and detailed studies. Both the model and the results of the work should be useful in diagnostic and planning studies for the southern Valley.

Sonoma Technology, Inc. applied statistical procedures - both correlation and regression - to a data base for Fresno and Kern Counties that was collected during the summer of 1984. The procedures applied may be of value in identifying data needed to better correlate emissions and ozone concentrations using field data alone. (obj 7)

Several approaches to PM-10 analysis should be considered. John Trijonis and Glen Cass have experienced success in statistical analysis of data focusing on relating source and receptor composition for five fractions of the particles - sulfates, nitrates, organics, elemental carbon, and soil. Analyses beginning with both source and receptor data, and working toward the other, have been pursued. Use of both approaches, in sequence and iterating between them as understanding is gained, should be attempted. John Watson has applied several forms of receptor models, sometimes coupled with the use of Gaussian models, with some success. These too should be considered. Finally, photochemical models may have use in the analysis of the formation and concentration distribution of secondary particles. (obj 6)

Two approaches to the analysis of visibility-related data in the study of light extinction are in use: (1) statistical fitting and regression analysis, and (2) analysis of data based on equations derived using Mie theory. Availability of suitable data will determine if the second approach can be applied. In any event, attention given to the second approach will be helpful in identifying data needs. Several investigators have applied these approaches; their experience will be drawn upon heavily in selecting analysis methods. (obj 6)

4.2.4 Task 4. Carrying out technical support studies

Thirteen technical studies are recommended for gathering information or gaining understanding in support of planning Stage Two activities. These studies include:

> determining if procedures are adequate for identifying and quantifying hydrocarbon species in ambient samples in the Valley. Past hydrocarbon determinations have had a relatively high percentage of unidentified species. The reasons for this will be determined, and possible means for significantly increasing the percentage of identified species will be recommended. These procedures will then be tested through field sampling and laboratory analyses. (obj 2)

> assessing needs and options for meteorological and ambient measurements aloft. Measurements aloft typically are far less available, due to the greater difficulty and higher costs associated with their acquisition, than ground-based measurements. Experience suggests that one of the greatest deficiencies in past modeling and analysis efforts has been the limited quantity of such data. In this study, the need for data aloft will be determined, considering the analyses and modeling efforts planned. Then the best means for acquiring them will be identified. (obj 2, 5)

> developing estimates of the accuracy, precision and validity of air quality data. This effort would consist of evaluating sampling and analysis procedures, identifying and describing current methodological issues associated with air quality determinations, assembling and evaluating available information concerning standardization and interference problems, determining expected deviations from true values, assessing the importance of developing improved methods and the potential for modifying existing methods, and carrying out experiments and procedure development for selected methods which might improve the accuracy and validity of proposed measurements. Effort would also be devoted to determining accuracies and precisions needed in future data sets to address adequately the objectives of the project. (obj 2)

> assessing the representativeness of meteorological and air quality data collected routinely and the likely representativeness of data to be collected at planned new sites. The presence of local sources, poor siting, and inadequate procedures can impair the representativeness of field measurements. This effort would identify potential causes of nonrepresentativeness, survey current and future sites, and assess procedures, with the objective of assuring that field measurements carried out in Stage Two are indeed representative of the quantities that are intended to be measured. (obj 1, 2)

> developing a detailed plan for carrying out emissions determinations in Stage Two. This effort includes assessing the adequacy of current emissions information, identifying emissions factors and activity levels that are inadequately estimated, surveying "missing" emissions categories, determining the importance of improving knowledge of the emissions factor or activity level (sensitivity), identifying information that must be determined through field measurements, determining appropriate procedures for carrying out field studies, scoping the tasks in detail and specifying procedures for analyzing and compiling the information collected (including preparing an inventory). The effort includes consideration of biogenic and geogenic sources, and estimation of uncertainties and variabilities in emissions parameters. Added objectives of the effort include determining if best available procedures for estimating emissions factors and uncertainties in emissions estimates are adequate to meet project needs. (obj 4)

> determining if available windfield modeling capabilities are sufficient to support air quality modeling for the San Joaquin Valley and the Sierra Nevada at an acceptable level of accuracy. (obj 1, 5, 6)

> establishing the impact of limited mixing and stratification at night on the dispersion and mixing of reactants (VOC, NO_x) emitted at the surface and aloft. This effort would involve (1) field studies to determine the dispersion and mixing of emitted pollutants and the observed vertical and horizontal gradients in concentrations, and (2) modeling studies to determine the sensitivity of secondary pollutant concentration estimates to knowledge of the observed gradients. This issue is of particular interest in Kern County, where petroleum sources, which emit a large fraction of the county's NO_x inventory, inject pollutants into elevated layers at night. The extent of influence of these "elevated pollutants" on downwind ozone concentrations is inadequately understood. (obj 2, 5)

> determining if improved estimates of pollutant deposition rates need to be developed. This effort includes review of the literature, analysis of available data, evaluation of field measurement methods and needs, sensitivity studies to assess the importance of making improved determinations, assessment of the likelihood of improving knowledge of deposition rates significantly through field studies, assessment of priorities, and recommendations for field measurements in Stage Two. (obj 5)

> determining, through a review of the literature and consultation with experts, if cloud acidity may play a role in the damage of trees in the Sierra. The results of this study would be a key determinant in deciding whether to include acidity as a pollutant of interest in this project. (obj 2)

> developing a cost-effective approach and monitoring methodology for determining air quality and meteorological conditions and fluxes at the upwind boundary of the study region. This effort will involve scoping and evaluation, followed by limited field studies to test the proposed approaches. Based on the results of the field measurements, an assessment will be made of the amount and relative importance of pollutant transport into the San Joaquin Valley.

> developing procedures for determining extinction efficiencies of various categories of particles that contribute significantly to visibility impairment in the San Joaquin Valley through light scattering. An initial product of this effort will be recommendations for preliminary values of efficiencies based on a review of the literature and the results of a first series of measurements.

> estimating the contributions of various source categories to ambient organic particulate matter in the San Joaquin Valley. This effort will include evaluating current measurement techniques, comparing them in terms of advantages and disadvantages, evaluating the potential of new or modified techniques for improving estimates of source contributions, developing and/or demonstrating new or modified techniques, and recommending a plan for sampling, chemical analysis, modeling, and data analysis for organic particulate matter for Stage Two studies.

> assessing current knowledge of the chemistry of secondary particle formation in the atmosphere. This effort will culminate in (1) the formulation of a set of chemical reaction mechanisms which describes the rates of formation and size distributions for sulfur, nitrogen, and organic categories of particulate matter and (2) the identification of species which should be measured in Stage Two studies.

We recommend that these technical support studies be initiated at the inception of Phase 2. See Attachment G for a more detailed discussion of the thirteen studies proposed.

4.2.5 Task 5. Applying and testing the approaches developed in Task 3 using available data

Approaches selected for use in Task 3 will be applied for episodes and longer term periods using available data. Inadequacies or lacks of data will be noted, and the limitations that they impose determined. Comparisons will be made between predictions and observations to establish the predictive capabilities of the approaches or models, their reasons for failure, the difficulties in effecting comparisons, the difficulties in creating a firm basis for truly testing the performance of source-receptor relationships, the needs for independent, corroborative means of analysis, and the value of added data. (obj 7)

Once relationships are as well established as possible, they will be used for estimating the impacts on air quality of alternative emissions control scenarios, insofar as performance of the analysis methods justifies such studies. Coupled with sensitivity and uncertainty analyses, these efforts will support determination of data needs.

4.2.6 Task 6. Addressing the nearer term technical objectives using available techniques

The analyses carried out in earlier tasks will be directed toward the supporting and primary objectives of Chapter 1. As appropriate, added analyses will be identified and carried out. To the extent that these analyses are adequately supported by data and the results are indicative of likely consequences of control strategies, the findings will be reported to policy makers. Attendant discussions of uncertainty and sensitivity will be presented.

4.2.7 Task 7. Preparing reports

Five reports will be prepared: (1) a report delineating in detail the technical requirements, approaches, work statements, costs, and schedules for the technical support studies [Task 1]; (2) a report describing the data analysis and modeling efforts of Phase 2 and discussing in some detail methods, results and findings [Tasks 2, 3, 5, 6]; (3) a brief report to policy makers, presenting findings of the analyses and interpretive comments in non-technical language, along with a discussion of uncertainties and limitations associated with the findings [Tasks 5, 6]; (4) a brief summary of technical information deriving from the analyses carried out that is of relevance in planning Stage Two [Tasks 2, 3, 5, 6]; and (5) a report describing the technical support studies, the work carried out, the results, and a discussion of their applicability in planning and carrying out Stage Two [Task 4]. Reports (4) and (5) will be used in preparing the planning documents in Phase 3. [If circumstances warrant, the fourth report may be omitted and the discussion included in the second report.] The report detailing the plans for the technical support studies (1) will be prepared at the outset of Phase 2.

5. PHASE THREE OF THE PLANNING EFFORT - PREPARING AN OVERALL PROJECT PLAN AND DESIGN DOCUMENTS

In Phase 3, four planning documents will be prepared, as outlined below. Taken together, they will comprise the overall, detailed plan for the study through the early Stage Three modeling. Stage Three efforts will be discussed in the Project Plan; however, a detailed plan for Stage Three - should it be recommended for support - would be developed based on the findings of the efforts preceding it. Thus, the actual planning effort for Stage Three is deferred until completion of Stage Two and the early Stage Three modeling.

5.1 PROJECT PLAN FOR STAGE TWO

This volume will comprise a complete plan for the project. Its contents will include objectives, modeling and analyses needed to meet objectives, supporting data requirements, staging of activities, and detailed discussion of approaches. The overall document will be akin to those prepared as a draft protocol for SCCCAMP and a project plan for SCAQS.

5.2 FIELD DESIGN DOCUMENTS - FOR THE CONTINUOUS AND STAGE TWO INTENSIVE EFFORTS

This volume will contain a detailed monitoring plan for continuous data collection and for Stage Two intensive studies. The design documents will be similar to those prepared for SCCCAMP and SCAQS.

5.3. PLAN FOR PREPARING THE EMISSIONS INVENTORY

This volume will set forth a plan for developing emissions estimates and compiling inventories for VOC (speciated), NO_x, SO_2, and primary particles (by size and composition), including gridded inventories as appropriate. Precursors of ozone, primary emissions of particles, and precursors of secondary aerosols will be the pollutants inventoried.

As discussed earlier, attention will be given to developing estimates of emissions rates and activity levels and an inventory of requisite accuracy and completeness. The forms of the inventory will be dictated by the analytical approaches proposed for the ozone, PM-10, and visibility modeling and analyses. Such needs as hydrocarbon speciation, particle size, and particle composition will be given explicit attention. Biogenic and geogenic sources will be discussed as well as anthropogenic. Consideration will also be given to meeting the needs of Stage Three, insofar as is appropriate and practical. (The objective would be to design the inventory for Stage Two, with Stage Three needs in mind.)

The technical support study focusing on emissions determinations and inventory requirements will provide information and findings upon which this report is based.

5.4 PLANS FOR STAGE TWO TECHNICAL SUPPORT STUDIES

We anticipate that (a) a few technical support studies carried out in Phase 2 will be continued into Stage Two and (b) additional technical support studies may be recommended based on the experience gained in Phase 2 analyses and planning. Study definition will derive from information needs specified at the beginning of Phase 3. This report will delineate plans for each of these Stage Two technical support studies.

The four documents discussed will provide the full plans for the work described in Chapter 6, the proposed nearer term efforts.

SECTION III

STAGES TWO AND THREE

THE ISSUE-RESOLVING AND MODEL DEVELOPMENT STUDIES

6. STAGE TWO. THE ISSUE-RESOLVING STUDIES

In Section II (chapters 4 and 5) suggestions for Stage One activities are specified in some detail. Phase 2 of this stage must begin soon if the project is pursued, and its tasks must be clear. However, definition of Stage Two will develop through the efforts and findings of Stage One. Thus, it is premature to specify a plan for Stage Two.

Nonetheless, there is a need to conceive a general scope for Stage Two in order to have a point of departure for thinking about the effort and to provide a basis for envisioning its breadth and scale, and estimating its costs. Past experience enables "the sketching" of a general scope. We have undertaken this initial "prototype" scoping with the understanding that:

> it is a "first cut", albeit one based on experience.

> the actual scoping will be developed upon completion of Phase 2.

> a primary specific use of the scoping is to provide a basis for estimating schedule and costs.

For convenience, Stage Two activities are divided into five elements. In this chapter we outline the main components of each element, and where it would appear helpful, the purposes of the element. Please see Section 3.2 for an overview of the "first cut" scope of the Stage Two study.

6.1 ELEMENT 1. THE CONTINUOUS MONITORING EFFORT

The continuous monitoring network will consist of two components: (a) existing monitoring stations and (b) stations or sites proposed for this study.

6.1.1. Purposes of the network

The purposes of the continuous network are to provide:

> data to aid in determining categories of episodes and in assessing their frequencies of occurrence.

> the means for estimating variability in conditions occurring within classes of episodes.

> a means of assessing the representativeness of the intensive study episodes and days.

> a Valleywide information base for use in relating the results of intensive studies carried out in one part of the Valley to those carried out in other parts of the Valley at different times.

> a means for determining natural divisions of the Valley, allowing its segmentation into subregions of focus for the intensive studies.

> the major source of data for determining 24 hour and annual averages of PM-10 and PM-2.5 throughout the Valley and for documenting spatial and temporal pollutant distributions.

> a basis for estimating the primary and secondary fractions of the particle groupings, determining their chemical composition and identifying the contributing source categories.

> a basis for characterizing visibility in the Valley.

> a basis for determining the fractional contributions of various species to visibility impairment and identifying contributing source categories.

> a long-term data record of winds (in three dimensions) and pollutant concentrations at key locations for use in estimating the fluxes into, within, and leaving the basin and the contributions of the cities and major non-urban sources to Valley concentrations.

6.1.2 Proposed components of the network

The components of the continuous network, as now envisioned, would include:

> currently operating stations that monitor air quality and meteorology.

> monitoring components added to currently operating stations to provide a full monitoring capability. Depending on the components in place at a particular station, these added monitoring components might include:

- continuous ozone monitoring;
- continuous monitoring of NO and NO_x;
- an integrating nephelometer (continuous);
- light absorption measurements (continuous);
- hydrocarbon sampling, an average of two canisters per day during the ozone season;
- 24-hour average samples for PM-10 and PM-2.5, every third day, analyzed for mass, elemental composition, ions and carbon; and
- wind measurements.

> five to ten new air monitoring stations, each capable of carrying out a complete complement of measurements.

> SCAQS samplers at five or six of the new stations. These samplers were designed and constructed for the Southern California Air Quality Study. They will permit more extensive fine particle and gas measurements, including analyses for ions, carbon, ammonia, SO_2, nitric acid, and light absorption.

> added surface wind measurement sites. These sites would be placed "to fill holes" in the existing wind network.

> six added upper air wind measurement sites. Four soundings per "measurement day" are contemplated, using rawinsondes or pibals. Measurements would be made every third day, and every day during intensive monitoring periods.

> two aircraft devoted to carrying out routine measurement of ozone, b(scat), and VOC (one canister per flight). These aircraft would fly every third day, once per day, in the morning.

Figure 6.1 displays a map showing potential continuous monitoring sites.

6.1.3 Period of operation of the network

The continuous network would operate for one year, beginning in April 1988, in accordance with the base schedule. However, four of the sites having SCAQS samplers would begin operations early, in October 1987 if possible, in order to gather PM-10 and visibility data. In addition, all stations in the network would operate continuously through intensive periods. Particle, upper air wind, and aircraft measurements would be made every third day, plus every day during intensive periods, up to a total of 165 days.

See Attachment E for a detailed discussion of the proposed continuous monitoring activities.

6.2 ELEMENT 2. EMISSIONS STUDIES

Many issues must be addressed in establishing emissions factors and activity levels for sources in and upwind of the San Joaquin Valley and in preparing an inventory of emissions. See section 3.2.2 for a listing of topics of interest. Because of the diversity of issues and the need for careful and detailed planning, we have not prepared an emissions study plan for the Stage Two effort. Instead, we propose that one of the nine technical support studies be devoted entirely to planning this work. The detailed work plan for the technical support study will be prepared in Phase 2, task 1 (see section 4.2.1). See Attachment G for a synopsis of the proposed technical support study.

Scoping efforts for developing the emissions study have thus far been limited to outlining a logical sequence of tasks. This task sequence is presented in Attachment F, as a part of a discussion of emissions information needs, data availability, and proposed Stage One and Two activities.

6.3 ELEMENT 3. INTENSIVE STUDIES

Intensive studies are those wherein diverse monitoring resources are put into use for a limited time to collect a rich and varied data base during periods of particular interest. Periods of interest for ozone occur during the summer months, whereas periods of interest for PM-10 and visibility occur in the summer, winter, and autumn. Intensive studies typically are about a month in length.

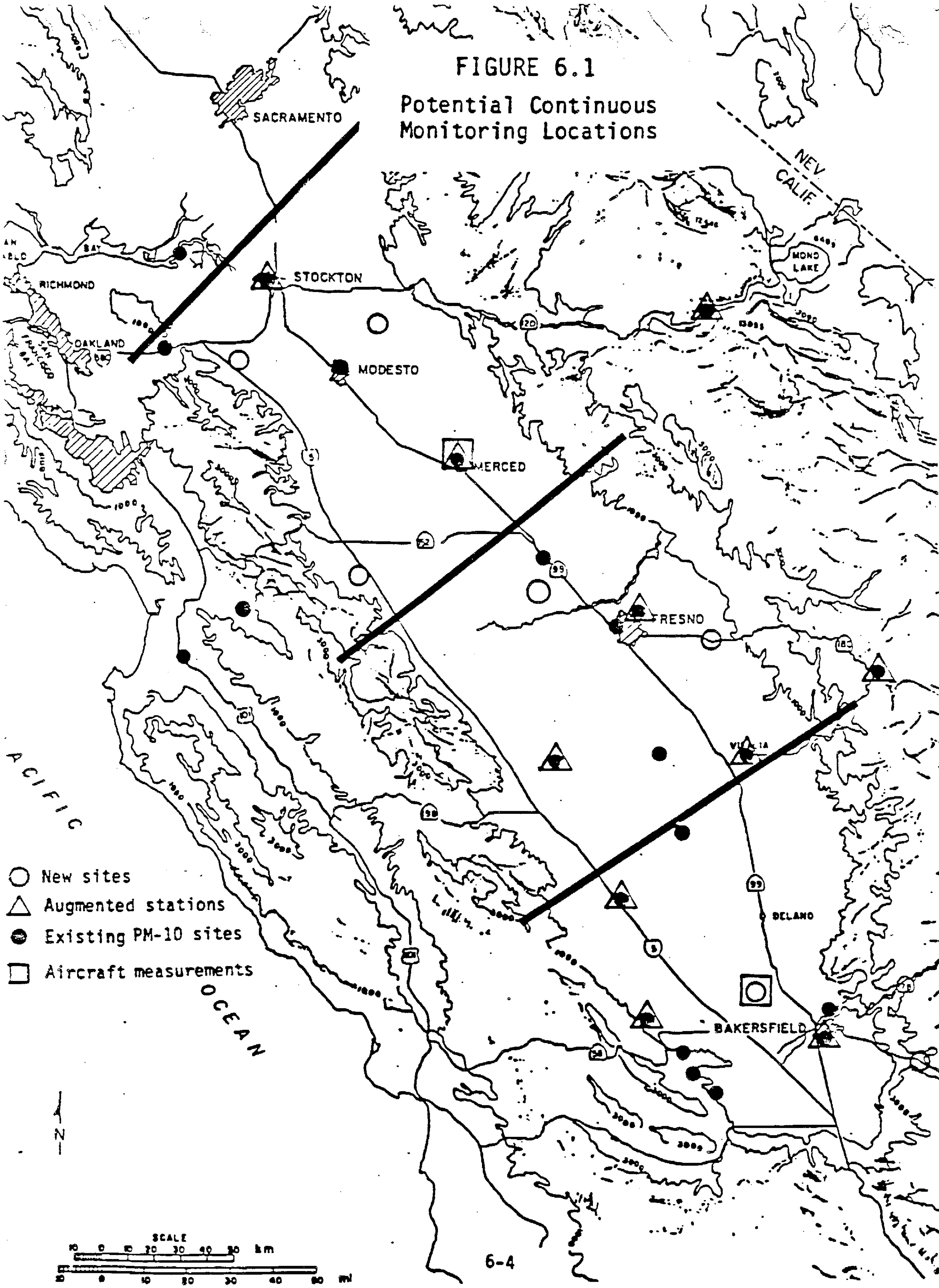


FIGURE 6.1
Potential Continuous Monitoring Locations

6.3.1 Purposes of the studies

The purposes of the intensive studies are to provide a rich and detailed aerometric data base which, along with continuous monitoring data, emissions estimates, and the results of technical support studies, will be suitable for use in a variety of analyses. These include:

> estimating the contributions of imported pollutants to adverse air quality in the Valley.

> estimating the impact on local air quality of the transport of pollutants from one jurisdiction to the next within the Valley.

> gaining an improved understanding of the transport processes and patterns that influence air quality in the Valley, the Sierra, and downwind areas.

> estimating the relative benefits of VOC versus NO_x emissions control for local source regions and for upwind sources.

> estimating the approximate levels of emissions reductions needed to meet relevant standards.

> evaluating the predictive capabilities of models.

> identifying geographical areas where controls should be applied.

> estimating the relative effectiveness of controls on elevated versus ground level sources.

> estimating (if feasible) the minimal data requirements for supporting development of a Valleywide model (Stage Three).

> characterizing the sources of PM-10 and visibility-reducing aerosols.

> assessing the relative importance of alternative aerosol formation mechanisms.

6.3.2 A proposed approach

The main characteristics of the proposed intensive studies efforts are the following:

> Three summer studies are suggested, the first in 1989 and the second and third in 1990. Three scheduling variants are discussed in section 3.4 and Chapter 8.

> Each of the intensive measurement studies are intended to cover a different portion of the Valley - the northern, central and southern regions. See Figure 6.1.

> More limited autumn and winter studies are recommended, to examine episodes associated with agricultural burning and stagnation-related fog events following winter storms.

> The design of the field studies will derive from the data requirements of specified analysis and modeling efforts. The specifications for analyses will, in turn, derive from the findings of Phase 2 modeling and analyses studies.

The studies would be carried out over periods of four to six weeks, with measurement periods of two to three days for five periods. Measurements would be made for a maximum of fifteen days per intensive period.

[Note: Carrying out intensive programs for three different portions of the Valley is one of several possible options. This option is used here as a "straw man" for scoping and costing. However, another option may be selected as the basis for the actual plan for Stage Two.]

6.3.3 Components of the summer intensive studies

The major measurement components of the summer intensive studies, as now envisioned, include:

> about five added sites, apart from those in the continuous network, located in regions of interest. These sites would be similar in measurement capability to those of the continuous network. Two of the added stations would have SCAQS samplers.

> additional VOC sampling and analysis and more frequent measurement of aerosols (four to six hour averages) at about 4 of the continuous and intensive monitoring sites on study days.

> ten additional upper air wind sites. About twelve pibal or rawinsonde releases per day would be made at these sites on study days.

> added surface wind measurement sites, if needed.

> airborne sampling using a LIDAR aircraft and three aircraft instrumented for air quality measurements. Each aircraft would make two to three flights per day on study days.

> added sites for VOC measurements on study days, at the surface and aloft.

> multiple tracer studies. About two to three multiple releases would be made during each intensive study. Releases would be made from upwind borders, from selected sources, and from aloft platforms, the latter to document elevated transport.

Flux measurements would be made using two aircraft and upper air wind stations. The LIDAR aircraft would monitor from above, while the air quality and wind measuring aircraft would fly spirals and traverses below. The two remaining aircraft, also flying spirals and traverses, would map spatial distributions of pollutant concentrations and the locations of urban plumes.

6.3.4 Monitoring during other seasons

The plans for intensive studies proposed are intended for summer periods - monitoring ozone, PM-10, PM-2.5, and visibility. More limited intensive studies might be performed during the autumn and winter as well, to document specific scenarios for the formation of PM-10 and visibility-reducing aerosol in the Valley. Studies might include measurement of source strength and transport of emissions from field burning, characterization of aerosols formed in fogs, estimation of ventilation rates during winter stagnation conditions, and transport during winter episodes. These studies would permit assessment of the relative importance of various aerosol formation mechanisms and the analysis of the geographical areas of influence of various source types and source regions.

See Attachment E for a detailed discussion of the proposed intensive monitoring activities.

6.4 ELEMENT 4. THE STAGE TWO TECHNICAL SUPPORT STUDIES

As noted earlier, technical support studies to be carried out in Stage Two will be those that (a) carry over from Stage One and (b) are identified during Phase 2 as being warranted. Those studies that we anticipate will carry over include:

> assessing the representativeness of meteorological and air quality data collected routinely and the likely representativeness of data to be collected at planned new sites.

Reason: Some of this work is best done once new sites are in place or when data are first being collected.

> establishing the impact of limited mixing and stratification at night on the dispersion and mixing of reactants emitted at the surface and aloft.

Reason: Measurements may be made concurrently with the first intensive study.

The scope of these efforts will be determined when the technical support study plans are prepared (see section 4.2.1). Whether it is appropriate to carry over other technical support studies will also be determined during this planning period. See section 4.2.4 for a listing and brief description of the technical support studies proposed thus far. See Attachment G for synopses of the proposed studies.

6.5 ELEMENT 5. MODELING AND DATA ANALYSES

The modeling and data analyses planned for Phase 2 (see Chapter 4) are a prototype for the Stage Two analysis and modeling efforts. The Phase 2 analyses will be thorough and detailed; they will provide a sound basis for deciding on a specific set of tasks for Element 5 of Stage Two. We refer the reader to Chapter 4 for an outline of proposed analyses and modeling efforts. See Attachment D for a complete discussion of modeling and analysis options, both for Phase 2 and for Stage Two.

The five elements form an integrated group of tasks, intended to acquire information and undertake analyses directed at the technical questions deriving from the objectives delineated by policy-makers (see Chapter 1). While the monitoring, modeling and analysis elements suggested here constitute a reasonable approach to the Stage Two study, based on past experience, the actual planning will await completion of Phase 2. The emissions and technical support studies will also be developed during this phase.

7. STAGE THREE. LONGER TERM MODEL DEVELOPMENT

The primary purpose of Stage Three is to develop a Valley-wide model useful for planning. Model development would be carried out only if (a) Stage Two efforts and findings are not adequate to meet the needs of policy-makers, and it is shown that Stage Three efforts are likely to provide the needed information or (b) policy-makers believe it of value to develop a longer range planning tool for continuing use.

Little effort has been devoted to planning Stage Three because of its tentativeness, the critical role that information gained from Stage One and Two studies will have in developing the plans, and the remoteness of Stage Three in time (it would not begin for three to four years). Thus, comments offered here are of a general nature; they do not represent a firm plan for Stage Three.

7.1 ELEMENT 1. EARLY STAGE THREE ANALYSES: THE USE OF MODELING TO AID IN PLANNING

Stage Two analyses and modeling exercises will be directed primarily at addressing the questions raised by policy-makers. As they will not deal with issues pertaining to planning the Stage Three studies, this first element will serve that purpose. Early Stage Three efforts are intended to aid in identifying improvements that might be made to the model(s) (which will focus on ozone and possibly particles as well) selected for use in Stage Three and in determining the data requirements for the Stage Three field program. Experience gained in Stage Two will be helpful in determining which model or models are most appropriate for development or adaptation for Stage Three. Sensitivity runs using Stage Two models - runs relating variations in meteorological and air quality parameters to predicted quantities of interest -would provide a useful tool (among others) in addressing field planning questions.

One issue we anticipate will be addressed at this time is whether the Valley should be treated as a whole in Stage Three, or whether it might be segmented into subregions for more limited scale monitoring and modeling. The Valley may be segmentable if (a) sub-regional, "integral" areas can be identified through the prior modeling work and subsequent analyses and (b) simulations are relatively insensitive to changes in upwind meteorology for a subregion, for the various meteorological conditions of interest in the subregion. The main options for the geographical extent of the study areas are (a) the Valley, taken as a whole, and (b) the Valley, divided into three subregions. These subregions are the northern region, comprised of San Joaquin, Stanislaus, and Merced Counties; the central region, comprised of Madera, Fresno, Kings, Tulare Counties; and the southern region, comprised of Kern County. This division appears natural, given the distribution of urban areas in the Valley.

Primary initial modeling-related activities in this effort might include making improvements in model formulation in accordance with what is learned in the field studies and subsequent analyses; identifying episodic scenarios appropriate for simulation and supportable using existing data;

setting up input files for simulations; carrying out appropriate tests to ensure that the simulations are useful for diagnostic assessment; and making runs to examine the spatial variability in concentrations of ozone, and possibly PM-10 and PM- 2.5. Additionally, it would be desirable to carry out sensitivity studies of the type discussed. An added category of sensitivity runs would be those focusing on emissions, boundary conditions and initial conditions, such as varying levels of imported pollutants and, separately, the levels of local emissions from designated sectors of the Basin. The results of the simulations (and supporting data analyses) would then be analyzed, with the objective of identifying specific data requirements beyond those recognized in Stage Two.

7.2 ELEMENT 2. DEVELOPING THE STUDY PLAN

The main focus of this element is to prepare the project plan for Stage Three monitoring and modeling studies, taking advantage of the knowledge gained from work carried out in the earlier stages and in Element 1 of this Stage. A set of reports is envisioned of the type and extent of those prepared in Phase 3 of Stage One.

7.3 ELEMENTS 3 AND 4. THE LONGER TERM STAGE THREE STUDY

Elements 3 and 4 consist of carrying out the monitoring and modeling activities delineated in the plan. The overall objective, as stated, is to develop a grid-based photochemical model (possibly applicable to particles as well) that will serve as a useful and reliable planning tool. The model should be easily "updatable" to reflect advances in knowledge.

Monitoring would provide a data base suitable for use in evaluation of model performance. The scope of the monitoring effort envisioned is typified by that of SCCCAMP and SCAQS. Modeling activities would include development and/or adaptation and evaluation of predictive performance.

SECTION IV

COSTS AND SCHEDULE

8. PROJECT SCHEDULE

A proposed "base" schedule for the project is shown schematically in Figures 1.3 and 8.1*. Its main features are:

> an intensive project planning effort (Stage One) from July 1987 to July 1988, including a complete analysis and modeling study and nine technical support studies.

> an issue-resolving study (Stage Two) comprised of five elements, substantially overlapping in time, from late 1987 to mid-1992. The first intensive monitoring program would be carried out in summer 1989, and the second and third in summer 1990. A limited continuous monitoring effort for PM-10 and PM-2.5 would commence in October 1987, with the full effort beginning in April 1988.

> a model development effort (Stage Three), should it prove necessary or desirable, beginning early in 1991.

Three alternative schedules are also offered, their rationale having been discussed in section 3.4. They are each described most easily through their variations from the base schedule.

> Schedule 2. Accelerated relative to base schedule. First intensive in summer 1988, second in summer 1989, third in summer 1990. See Figure 8.2.

> Schedule 3. Accelerated relative to base schedule. First intensive in summer 1988, second and third in summer 1989. See Figure 8.3.

> Schedule 4. Delayed relative to base schedule. Continuous monitoring to begin when funding permits. Assumed dates of inception: October 1988 for the limited initial effort, April 1989 for the full one year effort. See Figure 8.4.

If only an ozone study is funded, continuous monitoring will be carried out from April through October, rather than for a full year.

* Although this report has been partially revised since its first draft, the schedules shown in this section have not been updated to reflect the changes which have actually occurred.

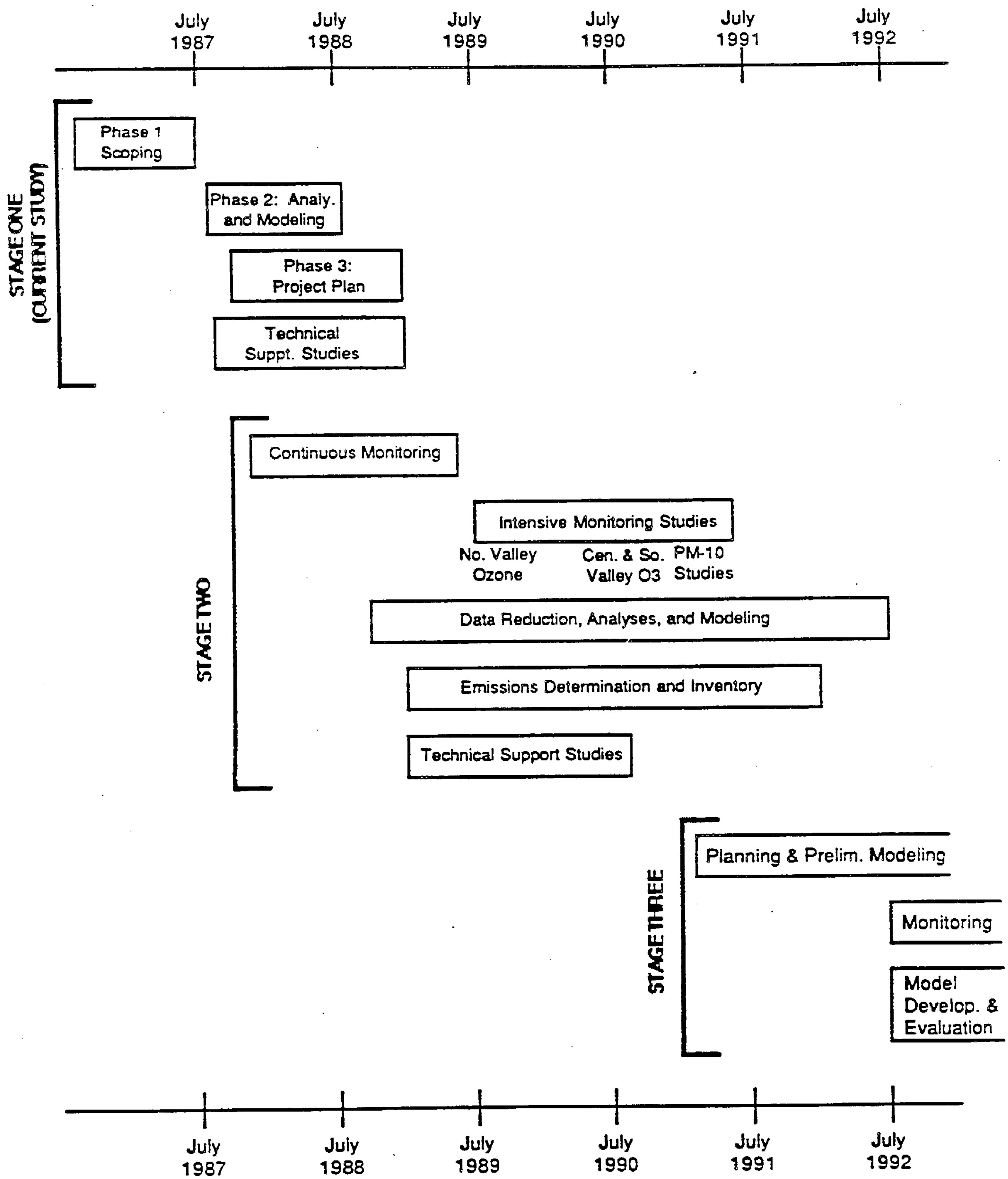


Figure 8.1. Base Schedule For San Joaquin Valley Air Quality Study

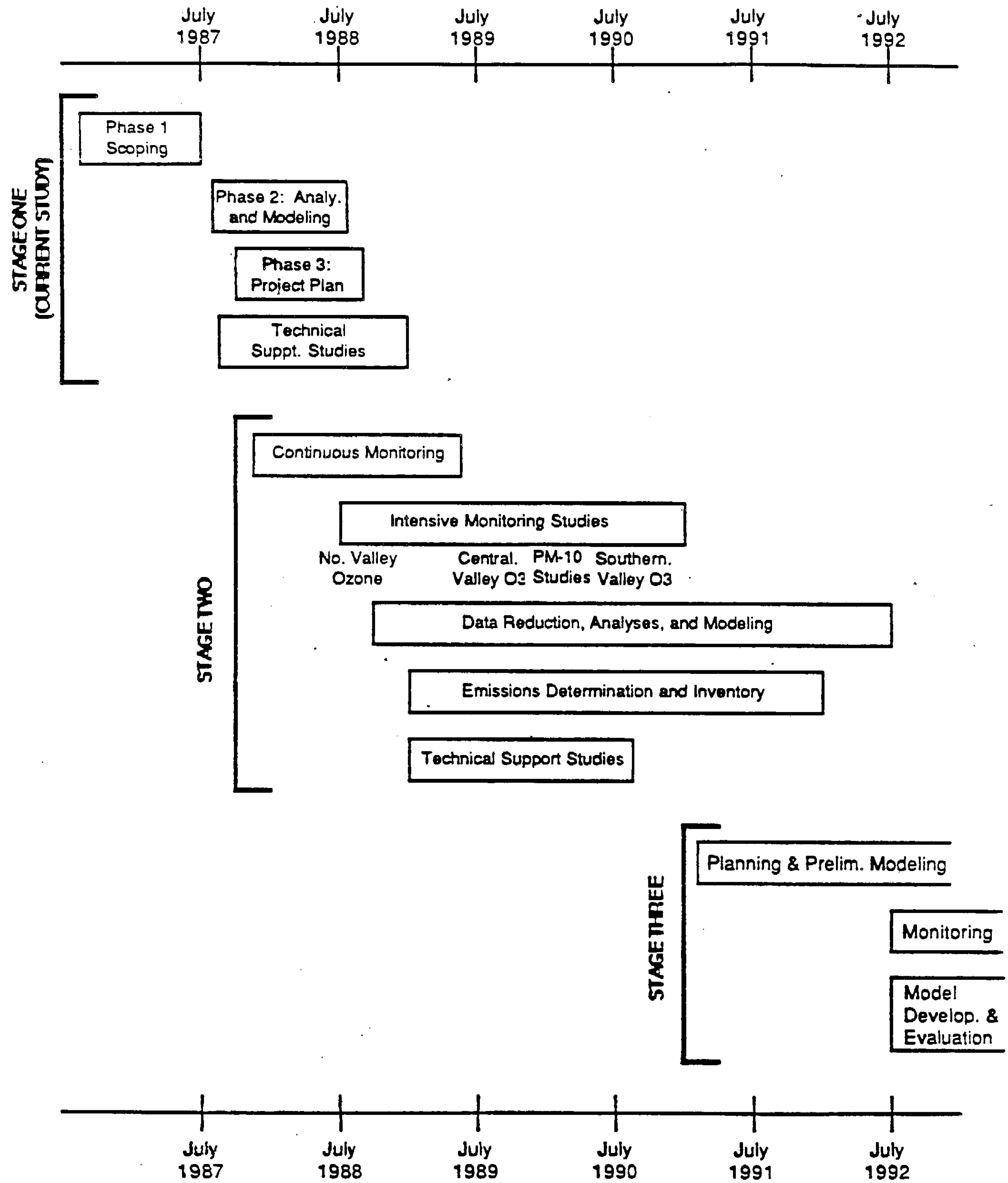


Figure 8.2. Accelerated Schedule For San Joaquin Valley Air Quality Study (Intensives in 1988, 1989, 1990)

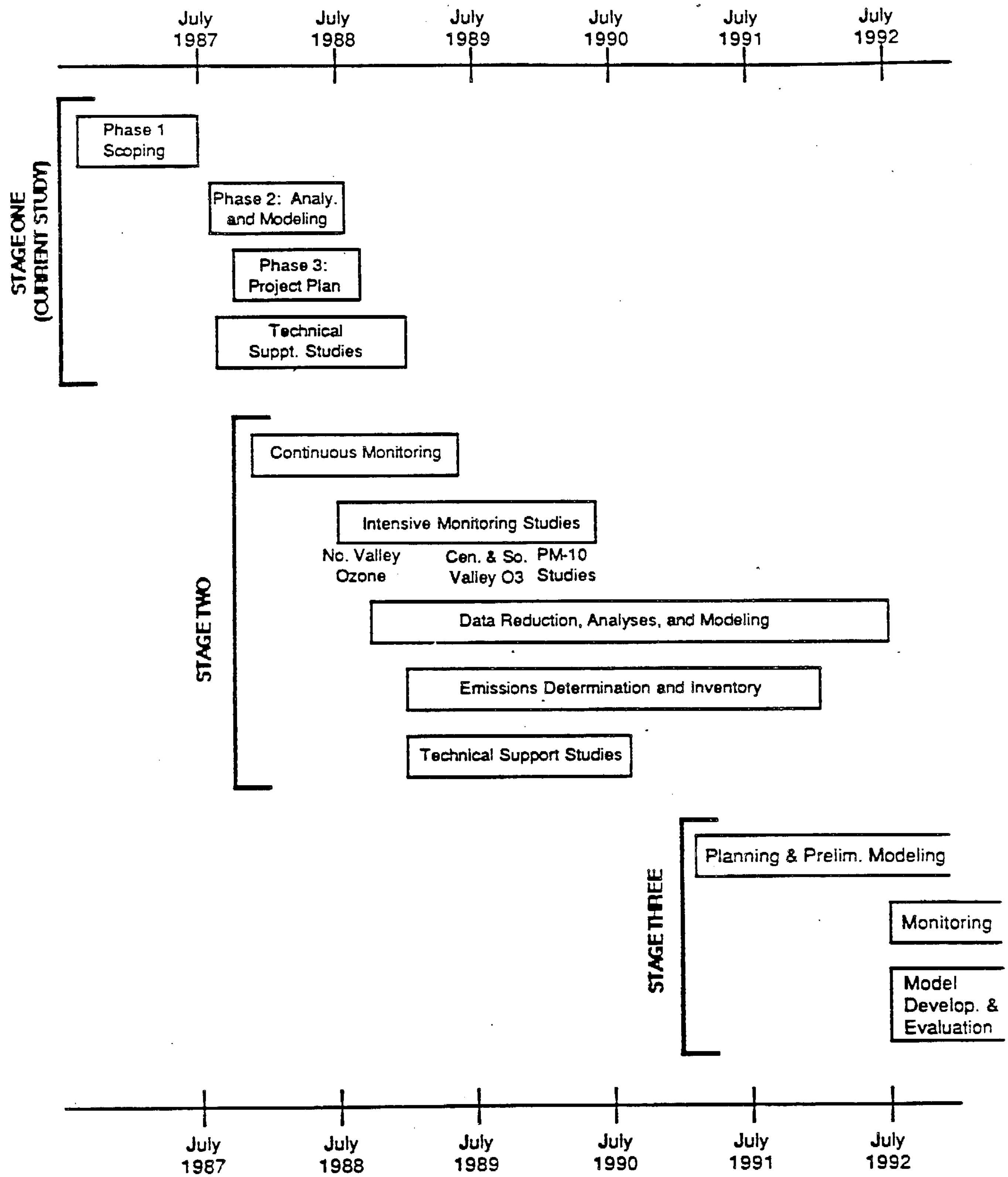


Figure 8.3. Accelerated Schedule For San Joaquin Valley Air Quality Study (Intensives in 1988, 1989)

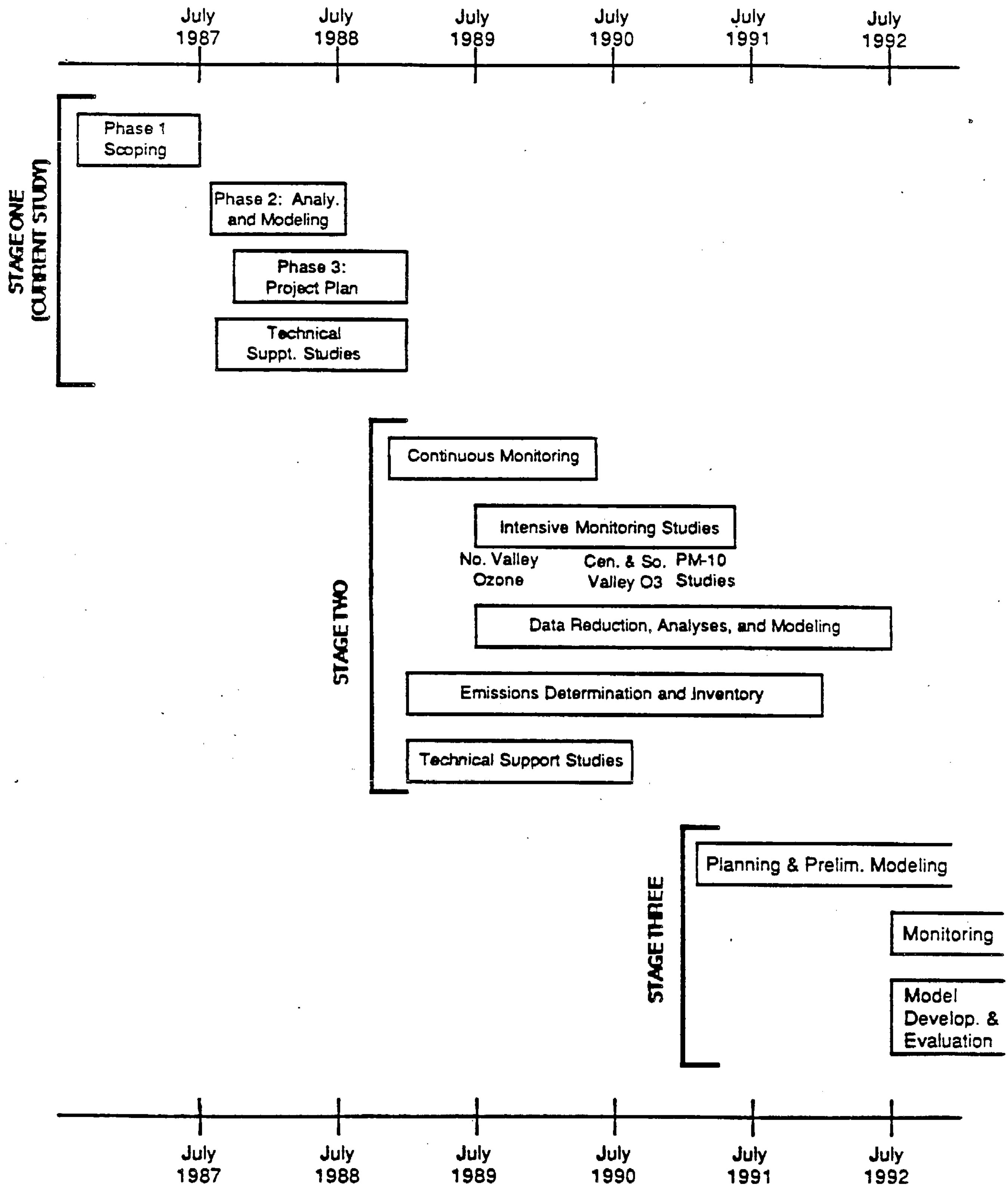


Figure 8.4. Delayed Schedule For San Joaquin Valley Air Quality Study (Intensives in 1989, 1990)

9. ESTIMATED PROJECT COSTS

Cost estimates have been prepared for each of the four scheduling options (see Figures 9.1 through 9.4). While the total costs are the same for each option, the costs are distributed differently from year to year. (Actually, costs will vary somewhat, depending on whether the three intensive monitoring efforts are carried out over two or three years. But the differences in cost are small compared with the uncertainties in these scoping estimates.)

The cost estimates given are for a study of ozone, PM-10, and visibility. We have also been asked to prepare cost estimates for a study of ozone alone. These estimates, for the base case and the three options, are shown in Figures 9.5 to 9.8.

The cost estimates presented are for the prototypical studies outlined in Chapters 4 to 7. While the Stage One studies are well defined, the Stage Two studies are only in the initial conception phase and the Stage Three studies are roughly scoped. Moreover, the estimated costs for the emissions and technical support studies are very approximate; improved costing must await completion of detailed planning studies focusing on these efforts. The scope of Stage Two will be refined and made more definite upon completion of Stage One. Cost estimates for Stage Two will also be refined at that time.

See Attachment H for a detailed discussion of costs.

FIGURE 9.1. Base Cost Estimate For The San Joaquin Valley Air Quality Study — O3 + PM-10 & Visibility
(Millions of dollars*)

	FY 87-88	FY 88-89	FY 89-90	FY 90-91	FY 91-92	5 year total
STAGE ONE						
Analysis/Modeling	0.8					0.8
Project Plan (four reports)	0.2					0.2
Technical Support Studies	2.2					2.2
Stage One Totals:	3.3	0.0	0.0	0.0	0.0	3.3
STAGE TWO						
Continuous Monitoring	2.9	2.4				5.3
Intensive Studies		0.9	4.6	5.3		10.8
Emissions - Determination†		1.4	1.1			2.5
- Inventory		0.1	0.4	0.3		0.8
Analysis/Modeling		0.3	0.6	1.0	1.0	2.9
Technical Support Studies		0.4	0.2			0.6
Project Coord., Mgmt. & Reports	0.3	0.3	0.3	0.3	0.1	1.3
Stage Two Totals:	3.3	5.7	7.2	7.0	1.1	24.2
STAGE THREE						
Modeling/Planning				0.2	0.4	0.6
Monitoring					1.0	1.0
Model Development/Evaluation					0.2	0.2
Stage Three Totals:	0.0	0.0	0.0	0.2	1.6	1.8 **
Stages One and Two Totals:	6.5	5.7	7.2	7.0	1.1	27.5
All Stages Totals:	6.5	5.7	7.2	7.2	2.7	29.3 **

Notes: *Estimates are in 1987 dollars. No assumptions were made about inflation. Columns may not appear to total properly due to roundoff artifacts.

†Cost estimates for emissions determination are very rough. Refined estimates will be a product of a Phase 2 technical support study.

**Stage Three would continue beyond 1992 if funded. Total cost would be about $10-15 million.

FIGURE 9.2. Accelerated Cost Estimate #1 For The San Joaquin Valley Air Quality Study — O3 + PM-10 & Visibility
(Millions of dollars*)

	FY 87-88	FY 88-89	FY 89-90	FY 90-91	FY 91-92	5 year total
STAGE ONE						
Analysis/Modeling	0.8					0.8
Project Plan (four reports)	0.2					0.2
Technical Support Studies	2.2					2.2
Stage One Totals:	3.3	0.0	0.0	0.0	0.0	3.3
STAGE TWO						
Continuous Monitoring	2.9	2.4				5.3
Intensive Studies	0.9	3.2	4.1	2.7		10.8
Emissions - Determination†	0.5	1.4	0.6			2.5
- Inventory		0.1	0.6	0.1		0.8
Analysis/Modeling		0.5	0.9	0.9	0.6	2.9
Technical Support Studies		0.6				0.6
Project Coord., Mgmt. & Reports	0.4	0.4	0.3	0.2	0.0	1.3
Stage Two Totals:	4.7	8.6	6.5	3.8	0.6	24.2
STAGE THREE						
Modeling/Planning				0.2	0.4	0.6
Monitoring					1.0	1.0
Model Development/Evaluation					0.2	0.2
Stage Three Totals:	0.0	0.0	0.0	0.2	1.6	1.8 **
Stages One and Two Totals:	7.9	8.6	6.5	3.8	0.6	27.5
All Stages Totals:	7.9	8.6	6.5	4.0	2.2	29.3 **

Notes: *Estimates are in 1987 dollars. No assumptions were made about inflation. Columns may not appear to total properly due to roundoff artifacts.

†Cost estimates for emissions determination are very rough. Refined estimates will be a product of a Phase 2 technical support study.

**Stage Three would continue beyond 1992 if funded. Total cost would be about $10-15 million.

FIGURE 9.3. Accelerated Cost Estimate #2 For The San Joaquin Valley Air Quality Study — O3 + PM-10 & Visibility

(Millions of dollars*)

	FY 87-88	FY 88-89	FY 89-90	FY 90-91	FY 91-92	5 year total
STAGE ONE						
Analysis/Modeling	0.8					0.8
Project Plan (four reports)	0.2					0.2
Technical Support Studies	2.2					2.2
Stage One Totals:	3.3	0.0	0.0	0.0	0.0	3.3
STAGE TWO						
Continuous Monitoring	2.9	2.4				5.3
Intensive Studies	0.9	4.6	5.3			10.8
Emissions - Determination†	0.5	1.4	0.6			2.5
- Inventory		0.1	0.6	0.1		0.8
Analysis/Modeling		0.5	0.9	0.9	0.6	2.9
Technical Support Studies		0.6				0.6
Project Coord., Mgmt. & Reports	0.4	0.5	0.4	0.1	0.0	1.3
Stage Two Totals:	4.7	10.0	7.8	1.1	0.6	24.2
STAGE THREE						
Modeling/Planning				0.2	0.4	0.6
Monitoring					1.0	1.0
Model Development/Evaluation					0.2	0.2
Stage Three Totals:	0.0	0.0	0.0	0.2	1.6	1.8 **
Stages One and Two Totals:	7.9	10.0	7.8	1.1	0.6	27.5
All Stages Totals:	7.9	10.0	7.8	1.3	2.2	29.3 **

Notes: *Estimates are in 1987 dollars. No assumptions were made about inflation. Columns may not appear to total properly due to roundoff artifacts.

†Cost estimates for emissions determination are very rough. Refined estimates will be a product of a Phase 2 technical support study.

**Stage Three would continue beyond 1992 if funded. Total cost would be about $10-15 million.

FIGURE 9.4. Delayed Funding Cost Estimate For The San Joaquin Valley Air Quality Study — O3 + PM-10 & Visibility
(Millions of dollars*)

	FY 87-88	FY 88-89	FY 89-90	FY 90-91	FY 91-92	5 year total
STAGE ONE						
Analysis/Modeling	0.8					0.8
Project Plan (four reports)	0.2					0.2
Technical Support Studies	2.2					2.2
Stage One Totals:	3.3	0.0	0.0	0.0	0.0	3.3
STAGE TWO						
Continuous Monitoring		2.9	2.4			5.3
Intensive Studies		0.9	4.6	5.3		10.8
Emissions - Determination†		1.4	1.1			2.5
- Inventory		0.1	0.4	0.3		0.8
Analysis/Modeling			0.7	1.2	1.0	2.9
Technical Support Studies		0.4	0.2			0.6
Project Coord., Mgmt. & Reports	0.2	0.3	0.5	0.3	0.1	1.3
Stage Two Totals:	0.2	6.0	9.8	7.2	1.1	24.2
STAGE THREE						
Modeling/Planning				0.2	0.4	0.6
Monitoring					1.0	1.0
Model Development/Evaluation					0.2	0.2
Stage Three Totals:	0.0	0.0	0.0	0.2	1.6	1.8 **
Stages One and Two Totals:	3.4	6.0	9.8	7.2	1.1	27.5
All Stages Totals:	3.4	6.0	9.8	7.4	2.7	29.3 **

Notes: *Estimates are in 1987 dollars. No assumptions were made about inflation. Columns may not appear to total properly due to roundoff artifacts.

†Cost estimates for emissions determination are very rough. Refined estimates will be a product of a Phase 2 technical support study.

**Stage Three would continue beyond 1992 if funded. Total cost would be about $10-15 million.

FIGURE 9.5. **Base Cost Estimate For The San Joaquin Valley Air Quality Study — O3 Only**
(Millions of dollars*)

	FY 87-88	FY 88-89	FY 89-90	FY 90-91	FY 91-92	5 year total
STAGE ONE						
Analysis/Modeling	0.5					0.5
Project Plan (four reports)	0.2					0.2
Technical Support Studies	1.7					1.7
Stage One Totals:	2.3	0.0	0.0	0.0	0.0	2.3
STAGE TWO						
Continuous Monitoring	1.5	1.2				2.7
Intensive Studies		0.7	3.3	4.8		8.8
Emissions - Determination†		0.9	0.4			1.3
- Inventory		0.1	0.2	0.2		0.5
Analysis/Modeling			0.4	0.5	0.5	1.4
Technical Support Studies		0.2	0.2			0.4
Project Coord., Mgmt. & Reports	0.2	0.2	0.2	0.3	0.0	0.9
Stage Two Totals:	1.7	3.3	4.7	5.8	0.5	16.0
STAGE THREE						
Modeling/Planning				0.2	0.4	0.6
Monitoring					1.0	1.0
Model Development/Evaluation					0.2	0.2
Stage Three Totals:	0.0	0.0	0.0	0.2	1.6	1.8 **
Stages One and Two Totals:	4.0	3.3	4.7	5.8	0.5	18.3
All Stages Totals:	4.0	3.3	4.7	6.0	2.1	20.1 **

Notes: *Estimates are in 1987 dollars. No assumptions were made about inflation. Columns may not appear to total properly due to roundoff artifacts.

†Cost estimates for emissions determination are very rough. Refined estimates will be a product of a Phase 2 technical support study.

**Stage Three would continue beyond 1992 if funded. Total cost would be about $8-12 million.

FIGURE 9.6. Accelerated Cost Estimate #1 For The San Joaquin Valley Air Quality Study — O3 Only
(Millions of dollars*)

	FY 87-88	FY 88-89	FY 89-90	FY 90-91	FY 91-92	5 year total
STAGE ONE						
Analysis/Modeling	0.5					0.5
Project Plan (four reports)	0.2					0.2
Technical Support Studies	1.7					1.7
Stage One Totals:	2.3	0.0	0.0	0.0	0.0	2.3
STAGE TWO						
Continuous Monitoring	1.5	1.2				2.7
Intensive Studies	0.7	2.8	2.8	2.4		8.8
Emissions - Determination†	0.5	0.8				1.3
- Inventory		0.2	0.3			0.5
Analysis/Modeling		0.2	0.6	0.4	0.2	1.4
Technical Support Studies		0.4				0.4
Project Coord., Mgmt. & Reports	0.3	0.3	0.2	0.1	0.0	0.9
Stage Two Totals:	2.9	6.0	3.9	2.9	0.2	16.0
STAGE THREE						
Modeling/Planning				0.2	0.4	0.6
Monitoring					1.0	1.0
Model Development/Evaluation					0.2	0.2
Stage Three Totals:	0.0	0.0	0.0	0.2	1.6	1.8 **
Stages One and Two Totals:	5.3	6.0	3.9	2.9	0.2	18.3
All Stages Totals:	5.3	6.0	3.9	3.1	1.8	20.1 **

Notes: *Estimates are in 1987 dollars. No assumptions were made about inflation. Columns may not appear to total properly due to roundoff artifacts.

†Cost estimates for emissions determination are very rough. Refined estimates will be a product of a Phase 2 technical support study.

**Stage Three would continue beyond 1992 if funded. Total cost would be about $8-12 million.

FIGURE 9.7. Accelerated Cost Estimate #2 For The San Joaquin Valley Air Quality Study — O3 Only
(Millions of dollars*)

	FY 87-88	FY 88-89	FY 89-90	FY 90-91	FY 91-92	5 year total
STAGE ONE						
Analysis/Modeling	0.5					0.5
Project Plan (four reports)	0.2					0.2
Technical Support Studies	1.7					1.7
Stage One Totals:	2.3	0.0	0.0	0.0	0.0	2.3
STAGE TWO						
Continuous Monitoring	1.5	1.2				2.7
Intensive Studies	0.7	3.3	4.8			8.8
Emissions - Determination†	0.5	0.8				1.3
- Inventory		0.2	0.3			0.5
Analysis/Modeling		0.2	0.6	0.4	0.2	1.4
Technical Support Studies		0.4				0.4
Project Coord., Mgmt. & Reports	0.3	0.3	0.3	0.0	0.0	0.9
Stage Two Totals:	2.9	6.4	6.0	0.4	0.2	16.0
STAGE THREE						
Modeling/Planning				0.2	0.4	0.6
Monitoring					1.0	1.0
Model Development/Evaluation					0.2	0.2
Stage Three Totals:	0.0	0.0	0.0	0.2	1.6	1.8 **
Stages One and Two Totals:	5.3	6.4	6.0	0.4	0.2	18.3
All Stages Totals:	5.3	6.4	6.0	0.6	1.8	20.1 **

Notes: *Estimates are in 1987 dollars. No assumptions were made about inflation. Columns may not appear to total properly due to roundoff artifacts.

†Cost estimates for emissions determination are very rough. Refined estimates will be a product of a Phase 2 technical support study.

**Stage Three would continue beyond 1992 if funded. Total cost would be about $8-12 million.

FIGURE 9.8. Delayed Funding Cost Estimate For The San Joaquin Valley Air Quality Study — O3 Only
(Millions of dollars*)

	FY 87-88	FY 88-89	FY 89-90	FY 90-91	FY 91-92	5 year total
STAGE ONE						
Analysis/Modeling	0.5					0.5
Project Plan (four reports)	0.2					0.2
Technical Support Studies	1.7					1.7
Stage One Totals:	2.3	0.0	0.0	0.0	0.0	2.3
STAGE TWO						
Continuous Monitoring		1.5	1.2			2.7
Intensive Studies		0.7	3.3	4.8		8.8
Emissions - Determination†		0.9	0.4			1.3
- Inventory		0.1	0.2	0.2		0.5
Analysis/Modeling			0.3	0.6	0.5	1.4
Technical Support Studies		0.2	0.2			0.4
Project Coord., Mgmt. & Reports	0.1	0.2	0.3	0.3	0.0	0.9
Stage Two Totals:	0.1	3.5	5.9	5.9	0.5	16.0
STAGE THREE						
Modeling/Planning				0.2	0.4	0.6
Monitoring					1.0	1.0
Model Development/Evaluation					0.2	0.2
Stage Three Totals:	0.0	0.0	0.0	0.2	1.6	1.8 **
Stages One and Two Totals:	2.5	3.5	5.9	5.9	0.5	18.3
All Stages Totals:	2.5	3.5	5.9	6.1	2.1	20.1 **

Notes: *Estimates are in 1987 dollars. No assumptions were made about inflation. Columns may not appear to total properly due to roundoff artifacts.

†Cost estimates for emissions determination are very rough. Refined estimates will be a product of a Phase 2 technical support study.

**Stage Three would continue beyond 1992 if funded. Total cost would be about $8-12 million.